Breaking Ground

THE MAGAZINE OF THE MASTER BUILDERS' ASSOCIATION OF WESTERN PENNSYLVANIA

MARCH/APRIL 2022

CONSTRUCTION TECHNOLOGY UPDATE

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PUBLISHER'S NOTE

A very interesting thing happened on my way through the research for the feature article in this edition of *BreakingGround* on the current state of technology. From nearly everyone I spoke with regarding building information modeling (BIM) came the same message that the technology adoption had stalled. That was unexpected.

In late 2006, shortly after *BreakingGround* was first published, I got a call from a former colleague at the Dodge Reports who was on his way back from a forum where he saw a demonstration of BIM. The colleague encouraged me to write an article about BIM, which he thought was going to revolutionize the industry. So, the January/February edition of the magazine included a look at what BIM was and how it was going to change construction.

A couple of things really stood out as I learned about BIM. First was how hard it was to find someone who could talk about it professionally here. The AIA did not know what I was asking. I was fortunate that AIA Pittsburgh's president suggested I call Burt Hill, saying, "They have all the cool toys." That turned out to be true and well-timed. The large architectural/engineering firm had just committed to doing all projects in BIM by the end of 2008.

During the conversations with Jeff Funovitz and Mark Dietrick in late 2006, the focus was on the technology challenges and the concerns about adoption. It was around that time that I learned about the Rogers Curve of technology adoption. It made sense that advances in technology were necessary to bring costs down and improve interoperability, the ability for BIM to communicate with all the design software that existed. It also made sense that there would be a lag in adoption while the bugs were worked out and costs reduced by economies of scale.

Because of the article, I was asked to moderate a few programs about BIM over the next year or so. During the question-and-answer period of one of those, the late Dwight Kuhn asked how BIM was going to make such a difference when he could not get architects to even share simple quantities with him while working on schematic budgets. It probably seemed like an arcane point to many in the room, maybe even a chronic complaint from an old guy. But Dwight was not a chronic complainer, and he was not really complaining about brick quantities. He was pointing out that technology was not going to fix a lack of trust.

More than 15 years later, BIM's adoption has been stunted by several factors. Certainly, cost is one. Owners have not found BIM compelling enough to use or mandate its usage widely. And the collaboration that BIM was supposed to engender has not fully developed yet.

There's been a lot written (including in the pages of this magazine) about collaboration and its impact on the industry. It feels like the hype surrounding collaboration has been greater than the substance. It's foolish to suggest that there is not increased collaboration in the construction industry; however, it is also absurd to suggest that we have entered a golden era of collaboration. Certainly, BIM has not been as much of a catalyst for collaboration as hoped.

When I search for a reason why there is not more collaboration among the parties in a construction project, ultimately I land upon the lack of trust as a root cause. I don't get the sense that architects, owners, and contractors truly believe that their counterparts wish to do them actual harm, but no one wants to have something they say be used against them later.

At NAIOP's February breakfast, the MBA's Dave Daquelente and Oxford Development's Mike Barnard were among the panelists addressing the topic of inflation and the disrupted supply chain. Both spoke candidly about having to build trusting relationships to manage projects during times of higher inflation and uncertain delivery. We're not talking about the kind of trust you have in your spouse here, just a level of confidence that that the players on your team are working to reach the same goal as you are. That is not a high bar, and it is a level that already exists throughout the construction process when contracts are written, loans are closed, and keys exchanged.

There won't be widespread adoption of a collaboration tool, like BIM, until there's widespread collaboration. It will be hard to achieve widespread collaboration without a baseline level of trust. Earning trust isn't that hard to do. Do what you say you are going to do. Show up on time. Don't steal from your partners. The problem here seems to be the extension of trust to another party. That too can be simple. The best way to find out if someone is trustworthy is to give them your trust.

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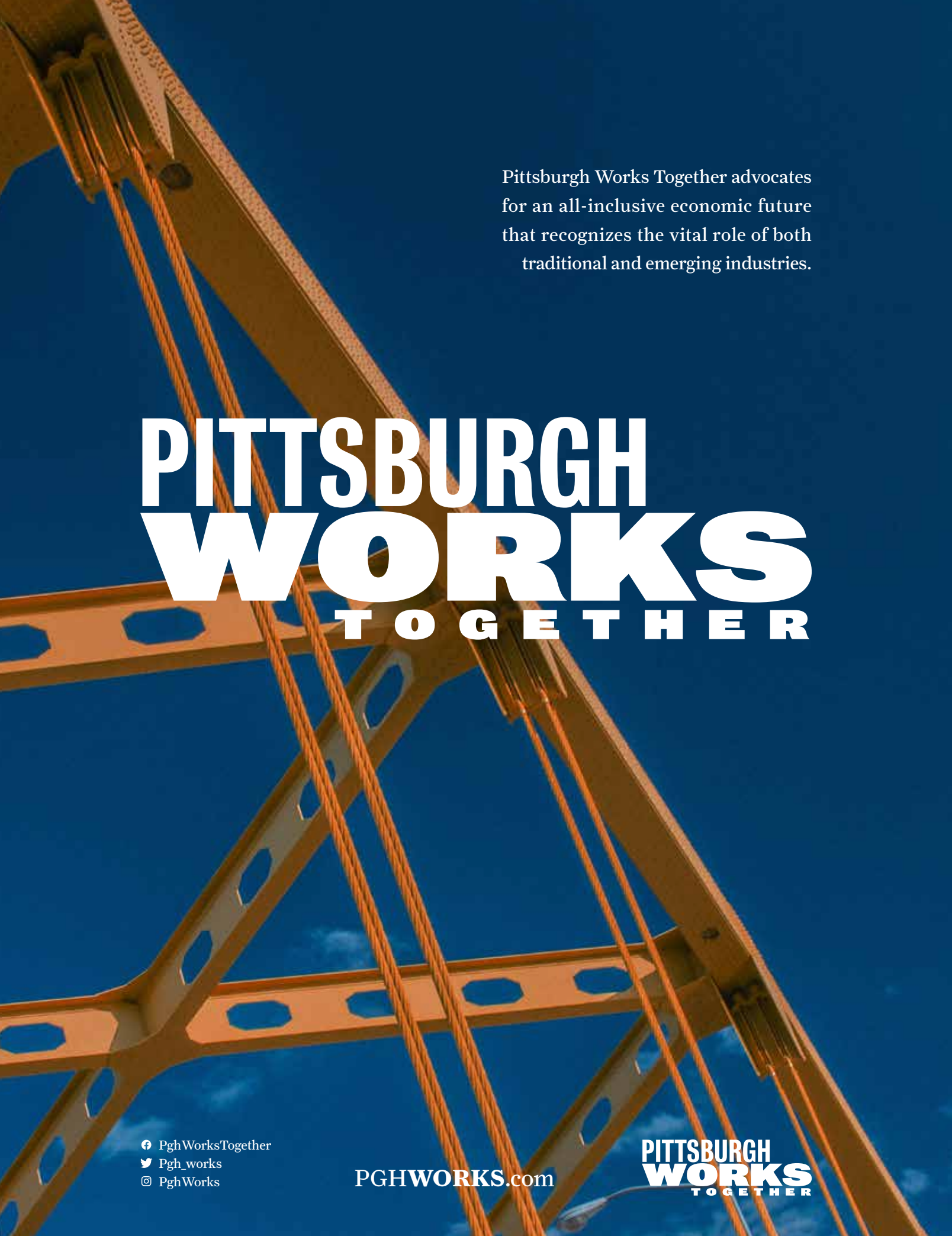
Jeff Burd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REGIONAL MARKET UPDATE

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At the end of 2020, with the relief of the CARES Act and Paycheck Protection Plan digested, the prevailing wisdom was that 2021 would be something of a rebuilding year for construction in Western PA. Vaccines promised a return to normal business activity for the hospitality segment of the economy. The sectors driving construction – healthcare, higher education, and industrial – entered 2021 with less damage than anticipated just six months earlier. With inflation running higher and supply chains disrupting schedules, it was assumed that contracting and construction volume would dip in 2021 before skyrocketing in the years that followed.

What took place blew up most forecasts and set the stage for one of the strongest recoveries in a generation.

Nonresidential/commercial construction activity in 2021 far exceeded expectations, even forecasts made six months into the year. Record volume of construction was driven by the unexpected revival of many projects deferred in 2020 – including some of the region's largest projects – and an increase in owner-occupied building. The former was driven by the economic surge that accompanied the rapid rollout of vaccines in spring 2021. The latter was likely driven by greatly improved private business financial results in 2020, primarily a result of the Paycheck Protection Plan and the reduced expenses during the first nine months of the pandemic.

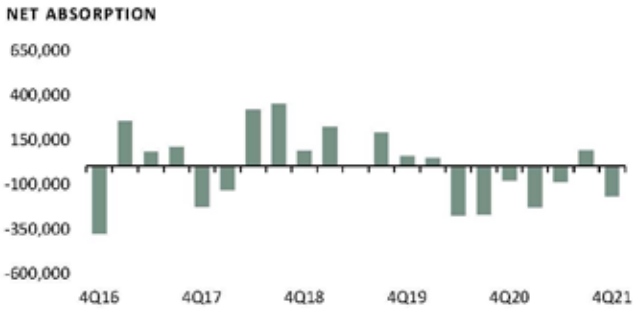
New contracting (plus the construction put in place at the Shell Franklin plant) exceeded $5.29 billion in 2021. Nonresidential/commercial construction was driven by four project types, plus roughly $700 million in contracts awarded as part of the Terminal Modernization Program at the Pittsburgh International Airport. Industrial construction was the most active sector, with more than $600 million in distribution and owner/occupied projects (excluding the Shell project). Multi-family projects totaled $582 million, as did the surprisingly active office market. The latter was boosted by the FNB Financial Center project. Higher educational construction saw $457 million in construction projects start in 2021.

Contracting volume in 2022 will almost certainly be lower than 2021, as there will be fewer major projects to bid – particularly at the airport and ALCOSAN – and the Shell Franklin plant will wrap up. Industrial development will push construction in that sector to higher volume, and the start of several of Pitt's $100 million-plus projects and Carnegie Mellon's science building should push higher education construction beyond 2021 levels. The healthcare construction pipeline also suggests a significant increase in spending, not including the expected start of the $900 million Heart and Transplant Hospital at UPMC Presbyterian. While the headline dollar volume may end up lower in 2022, the regional economic trendline is supportive of more project opportunities. Moreover, the pipeline of projects slated to begin in late 2022 or early 2023 portends a noticeable increase in work-in-progress in 2023.

	#SFD	#SFA	M/F	Total
Total Pittsburgh MSA 2021	2,411	1,060	2,337	5,808
Total Pittsburgh MSA 2020	2,337	1,000	1,144	4,481
% Change	3.2%	6.0%	104.3%	29.6%

Source: Pittsburgh Homebuilding Report

The final tally on new residential construction in 2021 was equally positive. Construction of new housing increased by nearly 30 percent compared to 2020. Most of the increased activity was due to the higher volume of multi-family units,



The pandemic induced office vacancy that accelerated what was a long-term negative trend in Pittsburgh. Source: Newmark.

which more than doubled to 2,337 units. That total excludes any adaptive re-use of existing buildings. Single-family construction was four percent higher than in 2020, with 3,337 new homes started. Single-family construction still suffers from fewer lots than the market is demanding, but volume was dragged down in 2021 more by the supply chain delays and building materials inflation. Virtually all builders experienced lost contracts due to higher prices, although new construction was likely impacted by less than ten percent overall.

Demand for both single- and multi-family properties remains strong in metropolitan Pittsburgh. The headwinds for single-family construction – insufficient lot inventory, supply chain disruptions, and erratic higher construction costs – will remain a problem in 2022 and may even increase despite strong demand. Pittsburgh Homebuilding Report forecasts that the supply constraints will result in a decline in single-family starts in 2022, likely one of less than five percent. The pipeline of multi-family projects is growing and should keep apartment construction above 2,000 units again. New construction will be again focused on the urban neighborhoods, but as many as 600 units are slated for suburban markets. And the increase in adaptive re-use of office building to multi-family Downtown will create several hundred new residential units.

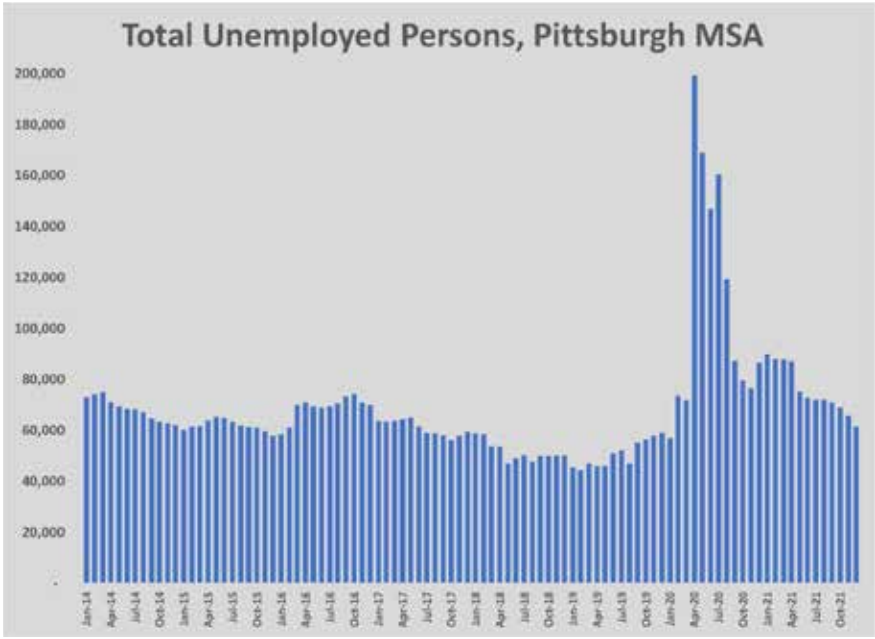
For the first time in more than a decade, public construction spending is expected to increase significantly in 2022. The federal Infrastructure Investment and Jobs Act is expected to bring an additional $4 billion in funding for bridges and highways, a boost that should increase infrastructure spending by 20 percent in 2022. The recent announcement of $885 million to repair the failing Montgomery Lock and Dam on the Ohio River in Beaver County, in addition to the $13 billion expected in federal infrastructure spending, sets up the next five years to have more opportunities for heavy/highway contractors.

Increased federal funding for education is expected to also give a boost to K-12 construction; however, political infighting in Harrisburg continues to derail plans to reform or fund the commonwealth's PlanCon reimbursement system. Until the legislature decides on a reimbursement structure, K-12 investment in facilities will lag. Like in recent years, there will be a few limited major K-12 construction projects. Expected to bid in spring 2022 are the $24 million Avonworth Middle School renovation and the $45 million Trinity Middle School and Intermediate School projects. The largest K-12 project in the region, the $90 million new Quaker Valley High School should bid by mid-year.

The reorganization of the PA State System of Higher Education (PASSHE) is likely to result in construction because of consolidation, but the savings from the reorganization have yet to be realized. The fruits that come from the consolidation will not produce an increase in construction until 2023 or later.

Pittsburgh's office market saw a strong rebound in leasing activity in 2021, following a 50 percent decline in 2020. Leases were signed for 846,000 square feet in 2021, according to JLL. That is a 69.2 percent jump from 2020. Pittsburgh's central business district did not see much of an

A worker from Goettle Inc. works on the foundations for the new terminal at the Pittsburgh International Airport. Photo courtesy Pittsburgh International Airport/Blue Sky News.



Sources: PA Department of Labor, Center for Workforce Information and Analysis, Pittsburgh Today.

increase, however, with leasing activity up only 7.5 percent year-over-year. For the Downtown market, vacancy rates are likely to be influenced more by the continued conversion of lower-class buildings to residential use through 2023. Daytime occupancy remains less than 25 percent Downtown and is unlikely to change significantly until after COVID-19 has devolved to endemic status and companies can more safely demand a return to work. Whether the workforce complies with those demands remains uncertain. For 2022 and 2023, new office construction will be owner-occupied or speculative development in the urban sub-markets, like Oakland and the Strip District.

Office market fundamentals continued to decline in 2021, apart from average rent. The continued imbalance in supply and demand in Oakland and the East End pushed rates above $36 per square foot on average, helping to boost the overall average rate to between $25 and $27 per square foot. The trends for occupancy and absorption suggest that rents will slide in 2022. Newmark reported negative net absorption of 165,000 square feet in the fourth quarter of 2021, the seventh negative quarter in the past eight. JLL reported negative absorption of nearly 908,000 square feet for the full year. CBRE reported total direct office vacancy at 16.5 percent, while Newmark and JLL reported vacancy 20.8 and 22 percent respectively of the office space available for rent (i.e. excluding owner-occupied space like the Tower at PNC Plaza).

With 1.2 million square feet under construction in a negative absorption marketplace, the outlook for office construction during the coming 12-to-18 months should be weak; however, office construction is primarily occurring in the high demand areas and are more likely to be occupied quickly. The office projects in the planning stages in those same sub-markets, like those proposed by Walnut Capital, Wexford Science + Technology, Oxford Development, and JMC Holdings, will begin in 2022 if there are no unforeseen events to derail the current economic trends.

There should be no such headwinds for the industrial sector in 2022. The real estate fundamentals – occupancy levels, absorption, and rental rates – are all trending higher. Class A industrial space is 97 percent occupied, even with 1.3 million square feet of construction deliveries in 2021. The 1.7 million square feet of new space under construction is expected to be absorbed quickly, clearing the way for more spec development. Two "unicorn" developments are in the entitlement process: a 1.05 million square foot distribution center being proposed by Suncap Properties in New Stanton and the 2.6 million square foot Amazon center proposed by Hillwood Properties in Churchill.

Rapid growth of Amazon and its e-commerce competitors have driven much of the industrial construction in Western PA and throughout the U.S.; however, there is increased demand from smaller warehouse operations and owner-occupied distribution. Industrial real estate is a favorite for institutional investors as well, and the low interest rates and cap rates are fueling more demand for new construction that will carry beyond 2022.

The construction market demand in Western PA endured the COVID-19 pandemic very well. As the second anniversary of the outbreak passes, the construction industry finds itself in a position that is similar to its status in 2019, with capacity insufficient to meet demand. Tight labor will pose problems in 2022, as will the supply chain disruption, and related building material inflation. Those challenges will be drags on construction, but the strong upward push of demand for new facilities will result in another strong year for the industry in 2022. If global commerce normalizes by the end of 2022, there should be few impediments to continued high levels of construction through the middle of the decade.

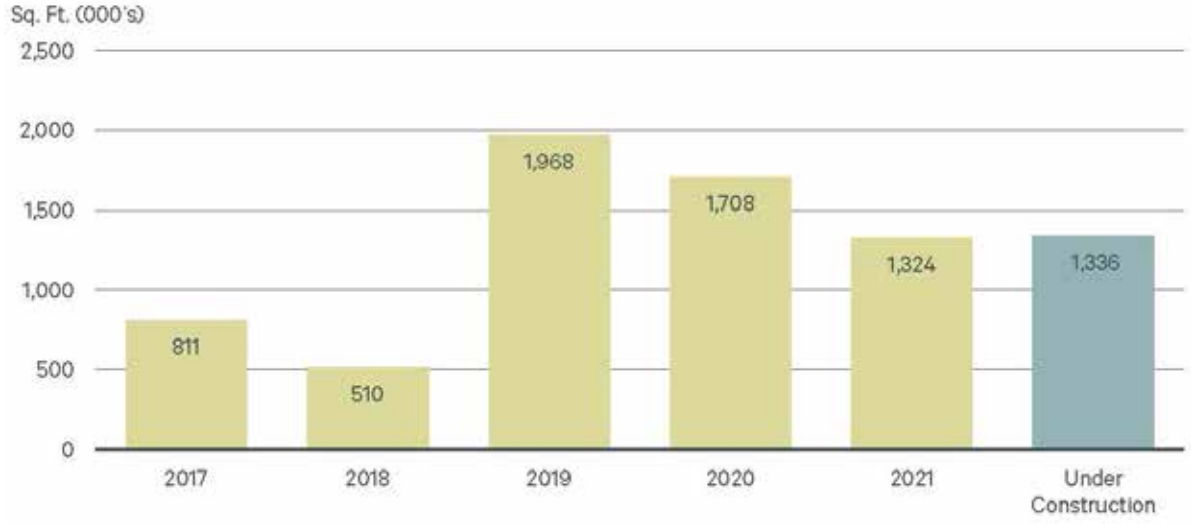
Employment recovery in Western PA lags that of the rest of the U.S. According to the PA Department of Labor and Industry, unemployment dipped in December to 4.3 percent, slightly above the 3.9 percent national unemployment rate. At the county level, Butler County had the lowest unemployment rate - 3.7 percent - while Allegheny County came in at 4.1 percent.

There have been some dramatic changes in the workforce since the last pre-pandemic data in February 2020, and it is difficult to assess whether the effects of COVID-19

FIGURE 4: Vacancy vs. Average Asking Rents

Source: CBRE Research, Q4 2021

FIGURE 5: Construction Deliveries



Source: CBRE Research, Q4 2021

have masked or exaggerated trends. Unemployment is significantly lower now than in February 2020. There were 61,400 persons unemployed on January 1, compared to 73,600 unemployed in February 2020. But the labor force has declined much more steeply, falling by 67,800 workers. In fact, the total number of persons in the workforce at the end of 2021 (1,157,400) was 10,300 lower than the total number employed in February 2020.

Assessing the impact of this trend is made more difficult by the fact that workforce participation in the U.S. has dropped similarly during the pandemic. While it would be reasonable to assume that the same causes are affecting the workforce in Pittsburgh as the rest of the U.S., the size of the workforce in Pittsburgh is not far off the level predicted in 2016 by the EMSI Burning Glass's Inflection Point report. Demographics – not a global pandemic – were what drove the forecast by Burning Glass. If that forecast is correct, Pittsburgh's unemployment rate is not likely to reach that of the U.S. rate during the current business cycle without an influx of workers that nets a gain of 15,000 to 20,000 new jobs. For an industry facing a surge in demand for skilled labor during the next 12-to-36 months, like construction, the current labor force participation rate is a serious head wind. BG

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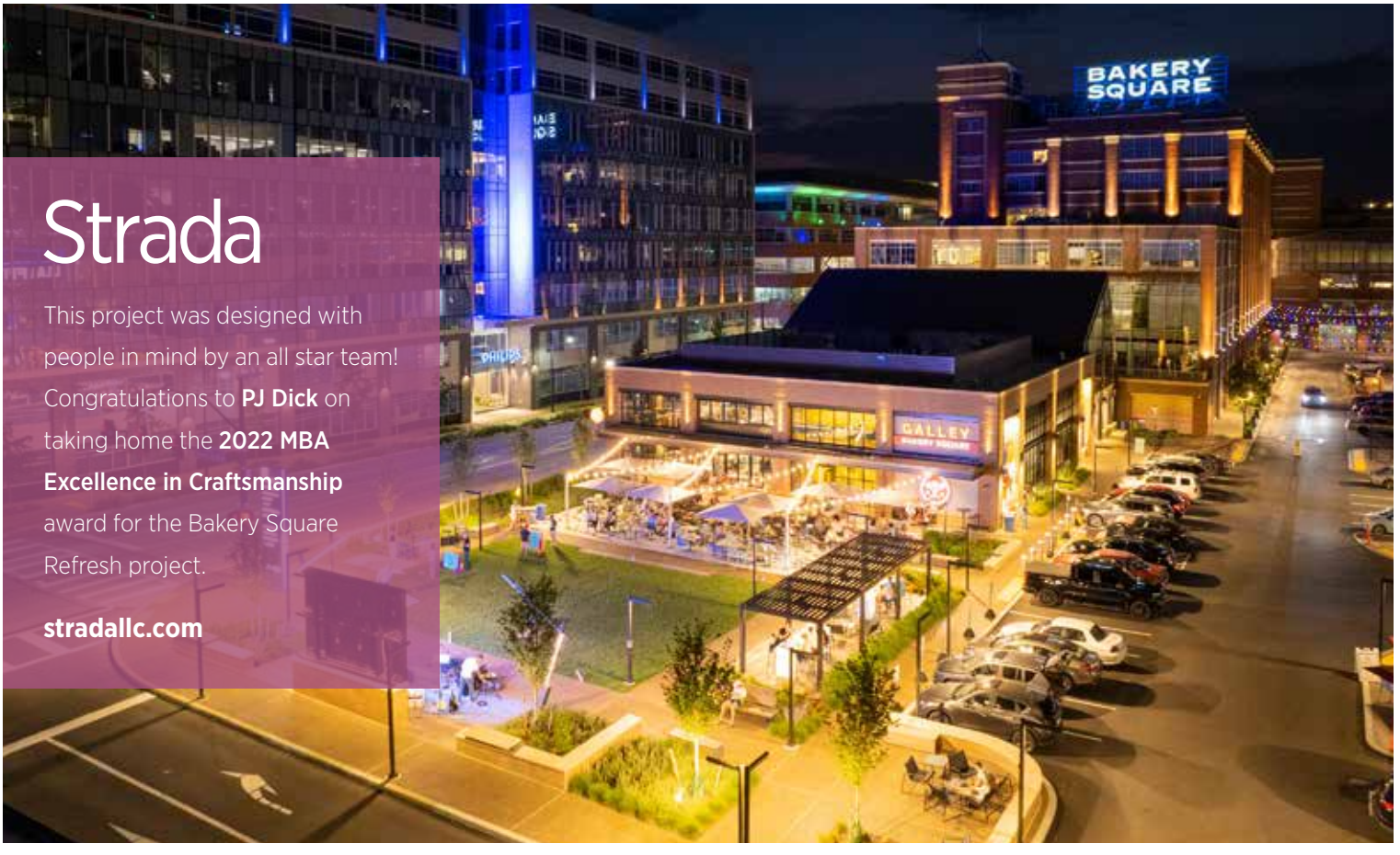

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NATIONAL MARKET UPDATE

Year-end reporting of construction activity confirmed that 2021 was an unusually strong year for construction and development, despite headwinds from inflation, labor shortage, and uncertainty caused by the surging coronavirus. The combination of surging economic demand, high levels of cash reserves, and cheap capital turned an uncertain beginning into a great year for construction.

On the residential side of the industry, home builders began construction on 1,595,100 homes in 2021, with single-family starts totaling 1,123,100 units. That marks the best year for single-family starts since 2006, which – as we found out in 2008 – was driven by financial products rather than demand. Multifamily construction experienced the best year since 1987, jumping 21.3 percent to 472,000 units. Housing permits, which tend to lead starts by 30 to 90 days, increase by 17.2% in 2021 to 1.725 million. Single-family permits rose 13.4 permits to 1.11 million, while multifamily permits spiked by almost 25 percent to 614,000 units. With permits rising faster than starts at the end of 2021, starts are likely to increase in 2022, despite slightly higher interest rates.

Construction spending overall also reached new highs in December. Total construction topped $1.6 trillion for the third consecutive month. While inflation pushed construction dollars higher, demand from private nonresidential investment recovered to mid-2019 levels by the middle of 2021.

Looking ahead to 2022 and 2023, construction economists see the economic recovery extending from residential to nonresidential construction. After declining by five percent in 2021, nonresidential construction is expected to climb by 5.4 percent in 2022 and 6.1 percent in 2023, according to the American Institute of Architects' (AIA) Consensus Construction Forecast. AIA convenes the economists from eight organizations focused on the construction industry, including FMI, Dodge Construction Network, Construct Connect, Moody's Analytics, IHS Markit, and Markstein Advisors. The panel expects slight declines in only the hotel, religious, and public safety sectors. The largest increases are forecast in industrial, retail and other commercial, health, and amusement and recreation.

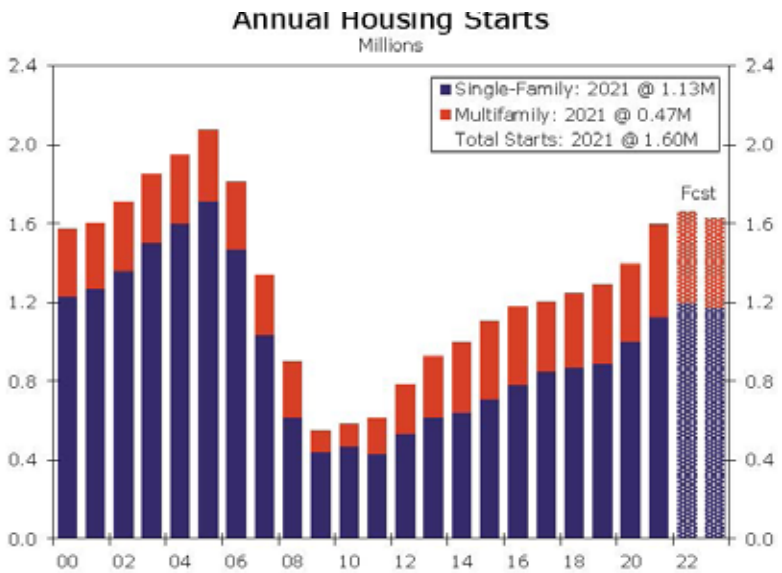
AIA's chief economist, Kermit Baker, notes in the comments announcing the forecast that in 2021 architects registered the highest average score for the Architectural Billings Index since 2007. Revenue at AIA firms increased by six percent in 2021 and is expected to grow by seven percent in 2022. Billings are a leading indicator of activity 12 months in the future.Ken Simonson, chief economist at the Associated General Contractors (AGC), sees the challenges to the construction market in the near- and medium-term coming from the supply side of the equation. Simonson acknowledges that demand could be diminished by pullbacks because of further virus outbreaks but cautions that the uncertainties in project costs and availability of materials present greater challenges to construction activity. He also warns that the pre-pandemic shortage of skilled workers and supervision has worsened.

As an illustration of the latter problem, Simonson notes that job openings in construction reached 350,000 at the end of 2021 an increase of more than 32 percent from a year earlier. Job openings for construction peaked at 300,000 in December 2018, arguably the height of the last business cycle.

Simonson also warns that the impact of inflation is likely to continue through 2022. Citing the 18 percent gap between the input costs and the bid prices for nonresidential construction, Simonson notes that similar variances in the past have lasted two years or more. The two most recent such prolonged variances, beginning in 2010 and 2017, each lasted two years. The current gap between costs and bids began in 2021.

The momentum of the U.S. economy makes it likelier that the impact of inflation, supply chain, and tight labor will reduce the rate of growth for nonresidential construction in 2022, rather than pulling the volume lower than in 2021.

Data on the fourth quarter and full year of 2021 began rolling out to the public as January ended. The picture painted of the economy by the data is one of extraordinary recovery in 2021;



Source: U.S. Department of Commerce and Wells Fargo Economics

Consensus Forecast	2022	2023
Nonresidential Total	**5.4**	**6.1**
Office	0.8	3.6
Retail & Other Commercial	7.5	4.9
Hotel	-0.4	13.5
Industrial	9.4	8.4
Commercial Total	**4.7**	**5.3**
Health	6.2	6.0
Education	3.5	6.1
Religious	-1.1	1.2
Public Safety	-1.3	5.6
Amusement & Recreation	7.7	6.0
Institutional Total	**4.4**	**6.0**

The AIA's Consensus Construction Forecast panel of eight construction economists sees growth in construction spending in 2022 and 2023.

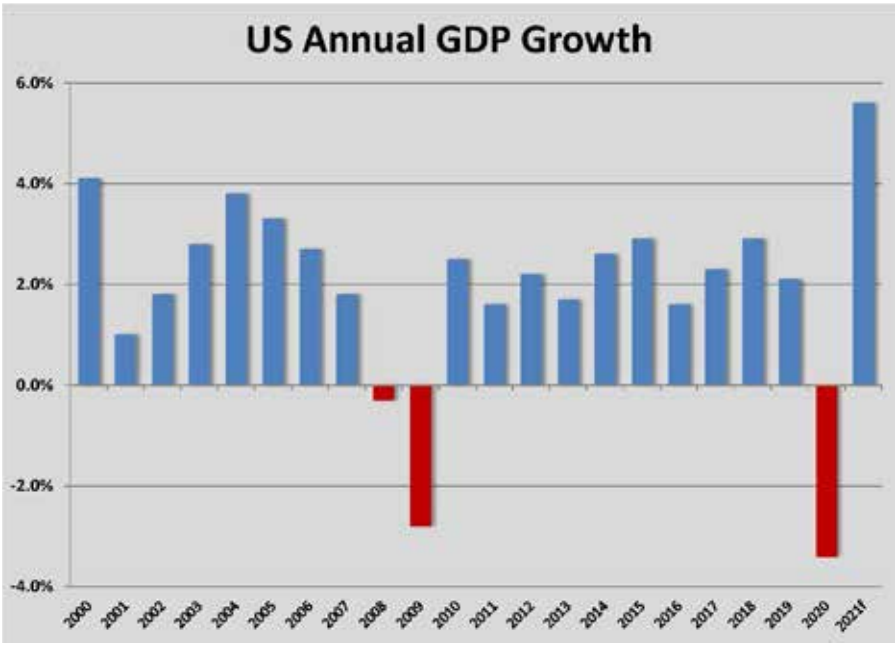
however, the polled consensus of American consumers is less optimistic. With COVID-19 circulating widely across the U.S. during the winter, businesses experienced serious disruptions. Many service businesses were forced to limit hours due to staff shortages caused by illness and resignation. The Census Bureau reported that the number of people not working due to illness reached an all-time high. Inflation soared for groceries, gasoline, and rent. Home prices appreciated by more than 15 percent again, pleasing homeowners but putting home ownership out of reach for many. These kitchen table concerns were exacerbated by partisan politics and media narratives.

The data on the economy tells a different story. Employment grew by 6.4 million jobs in 2021, pushing unemployment to 3.9 percent. That was the unemployment rate at the end of 2018. The number of unemployment claims fell precipitously throughout 2021, dipping below 200,000 per week in December and remaining in the low 200,000s in early 2022, roughly the same level as in early 2020. The number of jobs open began to fall in late January but remained well above 10 million openings. That is four million more openings than unemployed persons. The total number of persons receiving unemployment insurance compensation in January 2022 was 100,000 lower than in January 2019.

Hiring in December and January was consistent with the 12-month average, adding 510,000 and 467,000 jobs respectively. The uptick in hiring reduced the gap in the number of unemployed in January compared to February 2020 to 800,000. An unexpected jump in the workforce participation nudged unemployment up slightly in January to 4.0 percent, but unemployment seems to be a small factor in the current state of the U.S. economy. The Census Bureau's monthly jobs report, the Employment Situation Summary, has long been viewed as a barometer on hiring; however, it has become clear that the number of people employed has been limited less by slower job creation than by an insufficient number of applicants.

There is a growing disparity between participation rates among the prime workforce cohort (aged 25-54 years) and older workers. Participation for those 55 and older has fallen significantly after a spike when lockdowns ended in May 2020. Whether due to earlier retirements or fear of returning to work, the 55 and older cohort has been shrinking, about 800,000 workers fewer than in 2020. That runs counter to the long-term trends of growing workforce participation among older Americans. Combined with a decline in women in the workforce of about 1.5 million, the decline in workers aged 55 or older suggests that the U.S. economy may be looking at a secular shift to fewer workers.

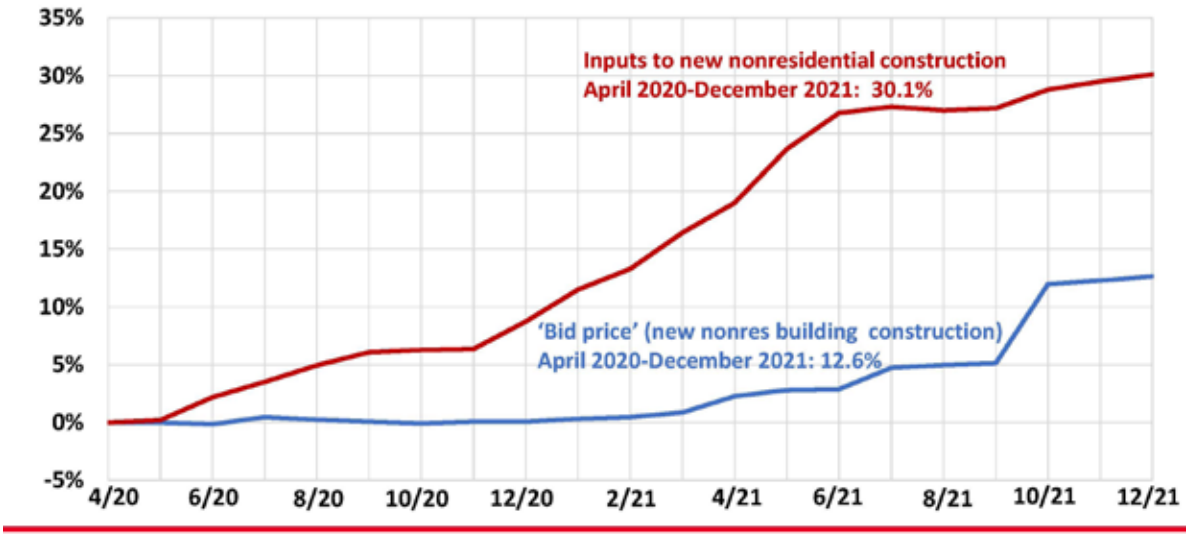
Whether or not such a shift is imminent, a continuation of this trend through 2022 will limit the growth of the economy. Through most of the two-year pandemic, it has been assumed that the hardest hit sectors of the economy – like hospitality, travel, and leisure – would see a surge in hiring after the public health concerns faded. Metrics like workforce participation rates and the "quits" rate suggest that restaurants, hotels, retail, and other industries with similar profiles may struggle to find workers. Many restaurants and bars, for example, were forced to maintain limited open hours in 2021 because of staffing shortages, not local mandates.



Source: Bureau of Economic Analysis.

Inputs and 'bid price' producer price indexes (PPIs)

cumulative change in PPIs, April 2020 -December 2021 (not seasonally adjusted)



9 | Source: Bureau of Labor Statistics, producer price indexes, www.bls.gov/ppi

The stresses on service businesses to maintain staffing had an impact on gross domestic product (GDP) growth during the fourth quarter. The first estimates of GDP growth showed that consumer expenditures on services outstripped goods purchases, but the pace of service spending slowed from the third quarter. Consumer spending remained strong overall, pushing GDP growth in the last quarter of 2021 to 6.9 percent on an annual basis. GDP grew by 5.7 percent for the full year compared to 2020. The biggest driver of growth in the fourth quarter was from inventory investment, which made up 70 percent of the growth. Companies rebuilt stock as the year ended after exhausting inventories to manage the ongoing supply chain disruption.

Household incomes and savings declined from the third to the fourth quarter (although still at high levels) as extended unemployment compensation ended.

Net exports contributed to GDP growth instead of subtracting for the first time since the pandemic began in second quarter 2020

Government investment subtracted from GDP growth because of the decline in unemployment compensation, state and local education investment, and federal defense spending.

The U.S. economy is positioned to grow above the long-term trend line again in 2022. Even absent population growth, demand from higher levels of employment and the higher levels of saving, coupled with forecasted higher global demand, should push GDP growth above three percent. That is somewhat lower than was forecasted six months ago; however, accelerated growth in 2021 and the assumption that inflation and higher interest rates will dampen global growth have muted the expectations.

Multiple threats have emerged as the economic threat posed by COVID-19 appears to be retreating. Inflation, particularly extended upward pressure on wages, could cut consumer spending significantly and increases the likelihood of deferrals of construction projects. Disruptions to the supply chain are not being resolved as quickly as hoped. Should the supply chain not improve in 2022, project delays will increase. Implementation of the Infrastructure Investment and Jobs Act will require design and bidding that will push realization of the increased spending into the latter part of 2022. And labor shortages will remain an underlying drag on productivity throughout the industry.

It is worth noting that the massive disruption caused by COVID-19 began as the global economy was slowing, possibly approaching recession. The strong recovery in 2021 came despite the threats posed by the pandemic, in part because the economy had begun to slow in 2019. The new threats left in the wake of the pandemic – high inflation, supply chain disruption, and declining workforce participation – will almost certainly keep construction activity from meeting demand in 2022. To the degree that less construction helps rein in those threats, that might be a good thing. BG

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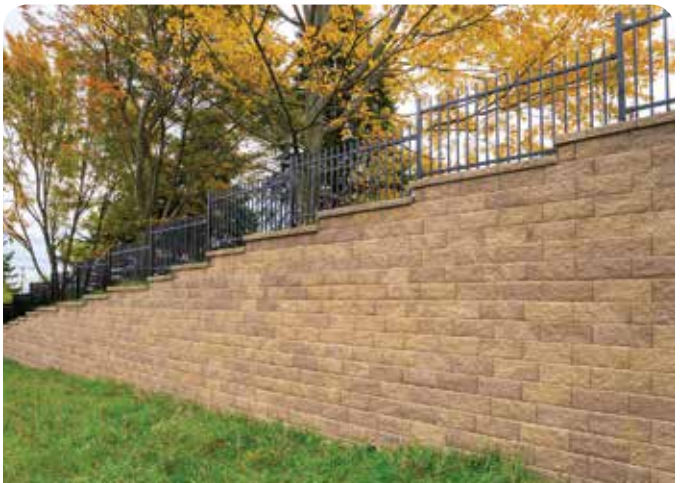
STONE VENEER



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WHAT'S IT **COST?**

The monthly reports from the Bureau of Labor Statistics in January and February revealed that price inflation, which had been limited to a handful of major items in 2021, had become more widespread at the beginning of 2022.

Data from the January producer price index release showed that inflation for new construction has leveled off since the spike from September to October 2021, when the year-over-year variance for new nonresidential buildings jumped from five percent to more than 12 percent. Ongoing inflation of 12 percent is going to dampen demand for construction in 2022, especially since price increases in a number of materials are significantly higher than the overall rate. The current levels may seem all the more shocking because the year-over-year rate of inflation at the end of 2020 had fallen to just over one percent, after reaching almost three percent in February 2020.

While the trend for most materials and building types was for lower month-to-month increases as 2021 ended, January saw jumps of between 2.5 and 3.5 percent in producer price indexes (PPI) from December across all inputs to construction. In many cases, the change in PPI from December to January was the same as from October to January, suggesting that prices were heating up again after stabilizing in the fourth quarter.

Among the outliers from the overall trend, only steel mill products, iron and steel scrap, and asphalt (at the refinery) were lower in January. Steel, which has increased 1.5 percent since October, is still more than double the price of January 2020. Lumber and plywood were again spiking, jumping 15.4 percent in January and 21.1 percent year-over-year. The trajectory of lumber prices will largely follow the lead of residential construction in 2022. Most materials saw double-digit year-over-year increases, and most of those exceeded 20 percent.

Wages also climbed in January and the pace of wage growth continued to increase. Excluding benefits, wages rose 3.8 percent year-over-year. Wage growth was only 3.2 percent year-over-yar in October.

The root cause of the higher levels of inflation – white hot demand meeting a supply chain still disrupted by pandemic conditions – has not changed. As the Federal Reserve Bank withdraws monetary support and hikes its Fed Funds rate, beginning in March, there will be downward pressure on inflation for the first time since the outbreak of COVID-19 in 2020. Strong demand will also motivate improvements to the supply chain, the fruits of which have begun to be felt on the consumer side. And, beginning in April, year-over-year comparisons will be made to economic conditions that reflect the rollout of vaccines and the normalization of many businesses in 2021.

Bond markets continue to reflect expectations of a return to inflation of two-to-three percent inflation next year. Aggressive Fed actions are likely to cool the economy off slightly. But geopolitical issues are likely to keep steel, energy, and fuel prices high, which will reflect throughout the construction supply chain. BG

PERCENTAGE CHANGES IN COSTS Consumer, Producer & Construction Prices	Jan 2022 compared to 1 mo.	3 mo.	1 yr.
Consumer price index (CPI-U)	8.0	1.6	7.5
Producer price index (PPI) for final demand	1.1	1.9	9.7
PPI for final demand construction	3.6	4.3	16.1
PPI for new nonresidential buildings	3.8	4.5	16.5
Costs by Construction Types/Subcontractors			
New warehouse construction	6.3	6.1	27.8
New school construction	2.9	3.0	12.3
New office construction	4.1	5.1	17.0
New industrial building construction	4.3	5.2	18.2
New health care building construction	2.9	3.9	14.6
Concrete contractors, nonresidential	1.8	2.0	18.8
Roofing contractors, nonresidential	4.7	5.6	13.9
Electrical contractors, nonresidential	1.3	2.3	11.4
Plumbing contractors, nonresidential	0.8	2.3	11.4
Construction wages and benefits	N/A	0.9	3.5
Architectural services	0.1	0.8	2.5
Costs for Specific Construction Inputs			
#2 diesel fuel	5.1	(2.5)	56.5
Asphalt paving mixtures and blocks	1.1	5.2	18.4
Cement	4.8	4.4	8.9
Concrete products	2.0	3.2	9.8
Brick and structural clay tile	1.1	1.3	6.9
Plastic construction products	1.8	4.3	35.0
Flat glass	1.9	3.6	9.0
Gypsum products	4.9	5.2	23.0
Lumber and plywood	15.4	35.2	21.1
Architectural coatings	9.0	10.8	24.3
Steel mill products	(1.6)	1.5	112.7
Copper and brass mill shapes	4.1	2.2	24.8
Aluminum mill shapes	5.6	1.2	32.7
Fabricated structural metal	1.6	6.9	48.6
Iron and steel scrap	(10.7)	(4.6)	0.6
Source Bureau of Labor Statistics, Updated February 16, 2022 *Compiled by Ken Simonson, AGC Chief Economist*			


RH

CONSTRUCTION TECHNOLOGY UPDATE

There are a few concepts that are universally accepted in the construction industry. One of them is that the industry is slow to change, especially when it comes to adopting new technology. There is some logic to that.

Construction is one of the riskier ways to make a living. There is significant liability associated with all aspects of the business. Changing methods that have been shown to limit risk usually means increasing the level of risk, or at least the perception of risk.

Reality may be somewhat different from perception, however. The aversion to change is not limited to construction. Nor is it limited to technology. In fact, Dr. Everett Rogers, a sociologist and communications theorist who lectured worldwide, came up with an innovation adoption model that illustrates how humans respond to new ideas of all kinds. In short, the Rogers' Curve reflects human aversion to change by categorizing us into five groups. Not surprising, the two early adopting cohorts comprise only 15 percent of the population. Moreover, construction is not averse to innovation or technology. In fact, profitability relies upon them. But construction is such a diverse and diffuse industry that it is difficult to discern just how much change is being adopted.

The last 20 years have been a time of rapid technological change in construction. The past two years have seen unprecedented changes in how people work, including the application of technology. Following two decades of innovation, the 2020s may be a decade of adoption rather than accelerating innovation. For that reason, it may feel like the next few years are more dynamic than the past few years. After all, it is in the integration of technology that the change occurs.

Rogers observed that more than two-thirds of people adopt innovation after an observation period, which he called a "chasm." Those two groups of the majority he labeled "pragmatists" and "conservatives" that held back until the innovation proved itself. By Rogers' standards, you might view the current day as the chasm in construction technology adoption, but it seems much more likely that the industry is simply made up of more pragmatists and conservatives (in construction there may not be a difference between those two groups) that are adopting new technologies at an accelerating rate that is disguised by the wide variety of disciplines and companies involved in construction. Firm-to-firm, there appears to be no aversion to new technologies. The difference is in the degree to which the new technologies are being deployed.

Adoption of new construction technologies comes down to the return on investment and the will to invest. Like with many aspects of business, technology adoption is often a product of leadership.

The Technologies to Watch

For centuries, most of the innovation in the construction industry has been in materials, tools, and methods. Construction is an easy industry to describe with the dinosaur label, but it is fairer to see the industry as a constant innovator within certain boundaries. The limitations of safety, structural integrity, and function keep designers from wandering too far outside the lines. Yet architects, engineers, contractors, and manufacturers have routinely developed advances that allowed for better or faster construction, as well as better performance in the built environment.

Better cranes and stronger materials allowed for taller buildings. Coffer dams radically changed how underwater construction could be done. Improvements to mechanical and electrical equipment led to heating without fire, air-conditioning, and ever-improving energy efficiency. Technological advances like these only became commonplace after innovation and rigorous (and redundant) testing.

The development of the semiconductor and the integrated circuit meant as much opportunity for construction as for other endeavors. Adaptation of digital technology to construction, and adoption of new technologies, lagged general business and personal use of computers. The former is no longer true, but the latter remains a reality.

Here are the technologies having an impact on construction:

Building information modeling (BIM) is the process of creating a three dimensional (3D) digital representation of a project before building it. An accurate representation of

the building enables everyone involved in the construction to add information to the model, which acts as the construction and contract documents, without loss of information from design through occupancy.

BIM provides a framework for more collaborative delivery of projects, allowing participants with specialized expertise – engineering consultants, specialty contractors, or manufacturers – to add information and value to the design before it is tested by the bidding process or job site. Fully employed, BIM reduces change orders, eliminates spatial conflicts among the building systems, acts as a single repository for all the project's documentation in real time, and provides the project's owner with information that can be used to manage and maintain the completed project.

Similar to what happened with computer-aided design and AutoCAD, a clear winner emerged among application software for BIM. The preference for Autodesk's Revit is so strong that Revit has become the generic reference for BIM in the way that Kleenex did for facial tissues. The market dominance of Revit has made it simpler for the makers of other applications for construction – for schematic design, estimating, project management, and accounting – to become interoperable with BIM.

Modular construction is not new technology, but the expansion of modular techniques may be the most impactful advancement currently. In residential construction, manufactured housing comprises roughly 10 percent of the total U.S. starts each year, and the degree of finish available on manufactured units has advanced to near completion. In nonresidential application, modular construction has expanded to include mechanical and electrical systems, office systems, interior and exterior walls.

The advances in modular construction or prefabrication have accelerated with the adoption of BIM, which allows manufacturers and specialty contractors to fabricate sections of completed building systems that can be delivered to job sites for installation. The precision of the model, particularly when it drives computer-aided manufacturing or fabrication, gives contractors the confidence that what is fabricated in the shop will fit in the field.

Prefabrication allows contractors to preserve precious skilled labor. The controlled environment of the shop or

manufacturing floor ensures that materials respond as intended and elevates quality control. Given the global shortage of skilled workforce, modular construction is a timely relief-valve for productivity and a remedy for weather-related field problems. Properly planned, projects with high levels of prefabrication can be delivered faster and will have less construction waste and a lower carbon footprint.

Drones allow construction professionals to have eyes on a project that would not be practical in person. Camera-mounted drones are used to surveil and measure a project, making several processes dramatically cheaper and more effective. Enhanced with lasers, radar, and intelligent applications, today's drones are capable of adding value to a project that few other technological advances can.

Engineers are able to survey land aerially in a fraction of the time that it would take with crews on the ground. In selected situations, like steep or dangerous sites, drones are able to accurately measure without the risk that human surveying would require. Drones can be used to fly job sites, including interior spaces, for security monitoring. On large job sites, drones have proven quite useful in tracking equipment. Drones with lasers can measure cut and fill sites to monitor productivity, estimate quantities to be moved, and measure grading.

The use of **wearable** technology has grown rapidly over the past five years. Thus far, wearables have been the most diversely valuable technology advances deployed in construction. From boots to hard hats to gloves, "smart" wearable devices offered big advances in safety technology for field crews. Wearables tied to GPS or other locating applications are capable of warning craft workers in the field of dangerous conditions. Advances in biometric devices gave wearables the capability to warn workers, or field supervision, when they were fatigued or experiencing physical conditions that left them vulnerable to injury. Since March 2020, that same capability could help with tracing COVID-19 contacts to limit the community spread during the pandemic.

Wearable technology, when combined with other construction technology applications or artificial intelligence (AI), represents the best opportunity for a major leap forward for construction. Helmets equipped with digital eyewear can give workers a way to compare field conditions to the drawings, or BIM model, that describe the detail to be built. Using virtual reality (VR) or augmented reality (AR) devices in the same application allows workers to see the completed conditions. Enhanced with AI, wearables can anticipate conditions that represent safety hazards and alert workers and supervisors to avoid accidents. Data collected by wearable devices can be analyzed to draw conclusions about means and methods or logistics that cannot be drawn by humans engaged in supervision or project management of the job site. All of this technology exists and is being deployed on job sites today. With widespread adoption and continuous enhancements, wearable technology has the potential to prevent thousands of injuries and save hundreds of millions in expenses.

Combining wearable technology with mechanical technology, **exoskeletons** for construction workers are machines with motorized joints that provide extra support and power during repetitive movements like bending, lifting, and reaching. Exoskeletons originated in physical rehabilitation programs and are both electrically and mechanically powered. They are used as a tool to reduce injuries and increase efficiency for construction workers. The most common exoskeletons in use today support the back, knees, hips, and shoulders. The drawbacks for exoskeletons are cost and the relatively low level of adoption. It seems more likely that the path forward for mechanical physical assistance will be with **robots**.

Robots offer similar safety utility to construction as drones and exoskeletons, allowing access to dangerous or difficult-to-reach areas. Robots can also be used for lifting or distributing heavy materials or equipment throughout the job site. Laser-outfitted robots are being used to measure and layout under ground or in other locations that would be difficult for humans to traverse.

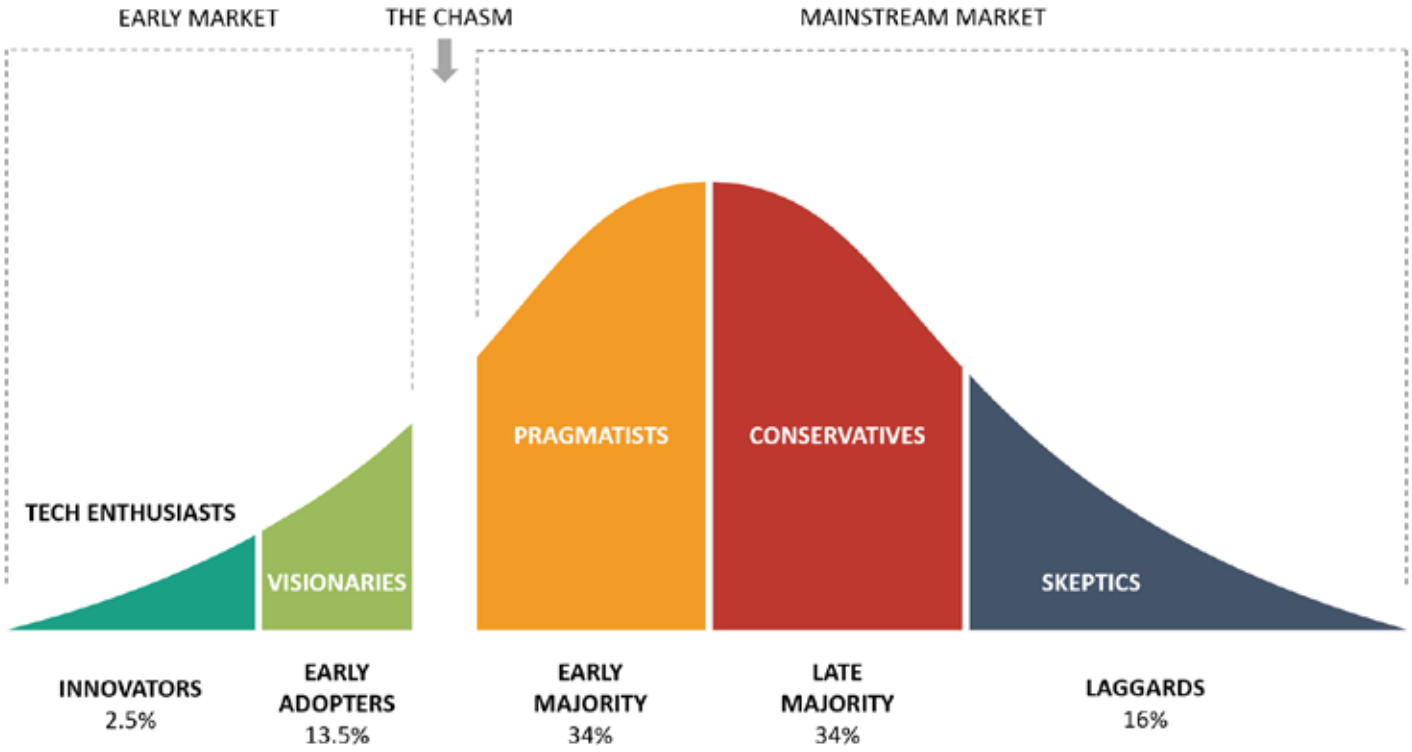
While the development of robots for construction has been limited, a look at how robots have been utilized in manufacturing suggests that there is significant potential for robots to be used on the active job site. Repetitive tasks and duties involving heavy or unwieldy materials are natural fits for humans to delegate to robots.

There are other digital technologies that offer potential significant utility to the construction industry but need further refinement or wider levels of adoption to bring costs down. Some of these, like VR/AR, are being used widely now, but in limited ways. The potential for visualization of physical conditions has been proven to accelerate and enhance training in athletics, suggesting that apprenticeship could be augmented by VR. That would be valuable in cold weather regions or as a way to continue apprenticeship in a meaningful way when work slows. Using VR during design can create conditions for project owners to visualize their facilities after construction (see article on page 64) to make better-informed decisions.

Some of the leading edge of technological advancement will likely have construction application. Artificial Intelligence is being used in most of the technological advances described above but is not being deployed by individual firms to improve operations. The potential for big data analysis to predict how workers are injured, profits are enhanced or erode, logistics improved, designs optimized, or buildings function most efficiently is enormous.

3D printing has also carved out a small piece of the industry today, primarily in the manufacturing of components. Although hundreds of 3D-printed buildings exist today throughout the world, the practical adoption of 3D printing of building systems is reliant upon technological and material advances that remain unforeseen. You need only visit Oakland or East Liberty to get a glimpse of the research that University of Pittsburgh and Carnegie Mellon scientists are doing to advance 3D printing, but the construction applications are further down the road. Construction will need the benefits of 3D printing – speed of construction, accuracy, and efficiency – when the technology is ready.

The application of **blockchain** technology to construction is further out on the horizon. Commonly associated with cryptocurrency, blockchain is a method of collecting and



Rogers Innovation Adoption Curve

distributing information in an extremely secure fashion. A blockchain developed for a unique project would allow for wider collaboration, decentralized information control, heightened security for information and physical assets, and vastly improved financial controls and payments

Adoption and Adaptation

Blockchain, 3D printing, VR/AR, and robots will require significant technological development before it is practical or cost effective to adapt to widespread construction usage. Many other emerging technology improvements have proven their value and cost justification but simply lack the critical mass of adoption. That seems most surprisingly true of BIM.

In 2007, only a few architectural firms were using BIM. General and specialty contractors eschewed BIM, preferring to wait and see when, or if, it was a technology that would be required of them to adopt. Five years later, BIM had been deployed on thousands of public and private projects, including dozens in Pittsburgh. Mechanical and electrical contractors had BIM rooms and touted their adoption as selling points. Construction managers hired virtual construction managers. It seemed imminent that institutional owners, like universities, hospitals, and governments, would use BIM models on all projects that then drove the maintenance and operations of their buildings. Ten years later, those prospects are no more imminent.

While the technology adoption for BIM and related applications has increased, it is nowhere near the saturation point. With each passing year, the laggard adopters are likely to find the technology gap hitting two of a business's most critical factors: sales and people.

"There are more opportunities than before where companies can't bid projects without using BIM," says Shane Zysk, marketing director for Precision Laser and Instrument. "Companies will find it harder to attract new talent if they are using technology that has existed since the 1930s."

In terms of talent attraction, Zysk's prediction is not likely to apply to architects. BIM is nearly as widely used as AutoCAD a generation ago. The gap between BIM's potential and its usage is not due to slow adoption by architects. Like most problems plaguing the construction industry, the gap comes from insufficient allocation of investment. Contractors, especially those that can use a model to increase productivity, have a strong incentive to invest in building a model on every project. Architects have widely adopted Revit or its competitors for designing but the application requires more of their time to include the level of detail than clients typically want to compensate.

"Over the past three or four years we have gone from 50 percent Revit drawings to 98 percent, but we aren't sharing the model more frequently," says Jonathan Glance, partner at LGA Partners. "If the level of detail for a sketch is 100 and

it is 500 for the highest level of detail, we are at 300. We can produce a model at 500 but only when the client is willing to pay for it."

Glance is clear that his staff is quite capable of detailing to the highest degree in BIM; however, he says it is the amount of time performing the due diligence with the client and the time spent translating the client's needs into design details that drives the cost.

"It's not a design software program problem. It's a thinking time problem," he says. "Designing in Revit means you have to think about it in terms of three dimensions. It's not the inputting of information that takes the time; it's the thinking."

"The potential of Revit has not been fully realized because the expense to include all of the information that can benefit a client in the operation and maintenance of a facility is something that clients are challenged to afford. We haven't had clients ask us to input that level of information for them to use in operating the facility," says John Schrott, president at IKM Inc. "Most owners don't have the skill set among their employees to manage the model. Revit is such that you can set up a preventative maintenance schedule associated with most of the equipment or facilities but most of our larger institutional clients have other software that they use for that purpose. Some of the reluctance may be driven by the fact that institutional clients have different buckets of money. The capital bucket doesn't want to pay for operational issues."

Mark Dietrick is a registered architect and director of services at Autodesk re-seller Case Technologies. An early adopter of BIM while at Burt Hill (now Stantec), Dietrick believes the penetration of BIM adoption slowed because the industry remains siloed.

"For small renovation projects, design firms are usually hesitant to use BIM. There is a feeling that for such a small space it's not worth it," Dietrick says. "I think designers should work out more of the logistics three dimensionally during design, but they don't. Designers tend to push that off on the coordination by the contractors. I think that is the root of a lot of the lack of acceptance and the other part of it is that there are models, and they are just not shared."

"In the bidding process, the share of projects in BIM is low," says Jeff Ivanco, virtual design and construction manager at Massaro Corporation. "One of our biggest problems is getting architects to release their models

before bidding. I ask on every project, but I'm told that the model won't be released until after the construction documents are out. During construction we try to use BIM as much as possible."

Glance points out that one of the disincentives for sharing is that BIM models include details during early design stages that will likely change by construction documents. Schrott voiced concern over liabilities associated with sharing the model. He also notes that models are more likely to be shared with manufacturers and specialty contractors.

"We share our model with manufacturers, which are able to plug it into their manufacturing systems to ensure that they understand the design intent. They still have to produce shop drawings but sharing the model helps with that process," says Schrott.

The specialty contractors echo Schrott's observation about their needs for the model, even at the early stages. With an increase in design-assist projects in Western PA, the trend is likely to be durable. For specialty contractors, BIM drives better coordination in the field and efficient fabrication in the shop, especially at a time when prefabrication of systems is rapidly expanding. Kyle Cygrymus, planning manager at McKamish Inc., explains that McKamish regularly creates a model for projects not delivered as BIM models.

"We like to use Revit for as much as we can. We'll get two-dimensional CAD drawings and convert them to Revit. The model drives our sheet metal fabrication," Cygrymus says. "Our field people use laser tape measure and enter the location of the new equipment on their laptops. We locate the new equipment on our model."

Cygrymus estimates that McKamish uses a BIM model of the mechanical systems to do approximately 80 percent of its fabrication.

"In the past couple of years there have only been two or three projects per year that have had full BIM models," observes Scott Chorey, vice president of construction and service at EMCOR/Scalise Industries. "Most of the time it's just been used for coordination drawings. I think part of the reason is that we haven't had as many large projects."

"BIM is moving in the right direction. We're partnered with McKamish on the UPMC Presbyterian tower and are working with the designers now so that we have input into the model in the early stages, rather than backtracking later," says Gordon Collins, vice president of RuthrauffSauer. "When you design in 2D you don't have to be as aware of the implications of the third dimension as you should be. In three dimensions the space constraints become apparent right away. Now the consultants are more regularly using 3D and have a much greater awareness of the space constraints at an earlier point."

One of the technologies that was expected to help expand the use of BIM is laser scanning. Technologies like lidar have made it possible to create digital representations of existing facilities through cloud points that can drive 3D models. Even as BIM's spread has stalled, laser scanning has grown.

"On existing projects, we will do a laser scan before and after demolition. Once the space is demolished, we will bring the specialty contractors in and do coordination with the point cloud and subcontractors' models," explains Ivanco. "We're also using VR for mechanical room layouts to see how things fit. It's hard to see by looking at a drawing or a model. We take clients and subs on a VR walk-through so they can see how much or how little space they have to work with."

Subcontractors have strong incentives to model the project, even if the architect and engineers do not develop the level of detail sufficiently. Modeling their specialty in 3D allows contractors to identify clashes between trades – plumbing chases that are laid out in the same space as electrical runs, for example – and to prepare as much prefabrication as possible. The latter is one of the most impactful applications of modular technology in Pittsburgh's construction market. Prefabrication on a large scale, like was done for AHN Wexford Hospital, has garnered attention, but prefabrication is occurring across the board for specialty contractors.

"We try to prefabricate as much as we can. Anything that we can control within our shop is much better," says Chorey. "Once things go out into the field, it is harder to control the quality and productivity. Once you start losing hours it's hard to recoup them. Prefabrication is the way of the future."

Jim Ferry, president of Ferry Electric Company, has integrated prefabrication into his company's business model, dedicating facilities and staff exclusively to optimizing the level of prefabrication used in almost every project.

"We have a dedicated prefab foreman and on every job, of relevant size, the drawings automatically go past him to put eyes on and see what we can prefab on those jobs," Ferry says. "He reviews the drawing with the foreman and project manager to plan."

Integration of field and office processes to the model was one of the promises of BIM that has been realized, even though full adoption may not be realized for decades. Integration of office processes – from estimating through project management and accounting – has been going on for decades. Advances in technology are improving the interoperability of those separate functions.

"We are working now on construction management software, called CMiC, which is similar to Procore. It takes your financial, payroll, and project management systems and ties them together," says Kristin Majcher, project manager at PJ Dick Inc. "When you run a cost report or job analysis report, you have real-time payroll information tied directly to your system, integrated with real-time invoicing information. That's something that we were lacking before. It answers the questions of how much of our payroll, how much of our invoicing is in the cost report.

"It is an ERP system. Not only does it manage what we're doing with our system, but there's a portal for architects, owners, and subcontractors so they can keep up with the drawings, submittals, and pay applications. It is integrated with our estimating operations. It also can tie in with BIM and different financial and scheduling systems."

Volpatt Construction has invested in an integration technology that grew out of gaming software. While exploring business diversification opportunities, Ray Volpatt Jr. developed a relationship with a gaming software developer, Ursa Leo, that was able to translate a Revit model into a virtual representation of the completed project, creating a virtual twin of the finished space. Volpatt was sufficiently impressed by the opportunity that he formed a business with his brother to bring the technology to the regional market.

"I think the industry is a slow adopter of technology. Few owners are using BIM in its current form," he says. "What we're trying to get into the market is a virtual twin technology. It is a tool for documentation of as-built conditions and can be turned over to the owner to use as a building management tool. What Ursa Leo does is take a Revit file and create a digital twin model. Using a gaming engine, they compress the file so that it can exist on the cloud. They turn a 120GB file into a

150MB file. You don't need a whole lot of bandwidth to use the model. You can use any device."

Aside from the visualization and documentation aspects of virtual twin technology, there is a valuable collaborative tool that Volpatt found compelling. If a user of the virtual twin encounters a field question, they can invite the architect or owner to a collaborative session by email or text. Participants in the chat can resolve the issue while sharing the virtual twin, with the conversation retained with the virtual twin. The virtual twin brings some of the benefits of a collaborative 3D model to a marketplace – particularly owners – that has not adopted BIM to any great degree.

On the non-virtual, physical job site, robots and drones are being used increasingly for preconstruction tasks.

"We have been using drones for about five years. I use it most often for pieces of ground that aren't safe for access," says Tom Turner, P.L.S., shareholder and project manager for Gateway Engineers. "We set ground controls surrounding an unsafe area, like a landslide, and the drone will pick up those ground controls and map the slide area. We used it last year, for example, on the Braddock lock and dam. The Corps of Engineers is going to redo that lock and dam and we did a preliminary survey of the area. That's another situation where you can't get very close to the area to be surveyed."

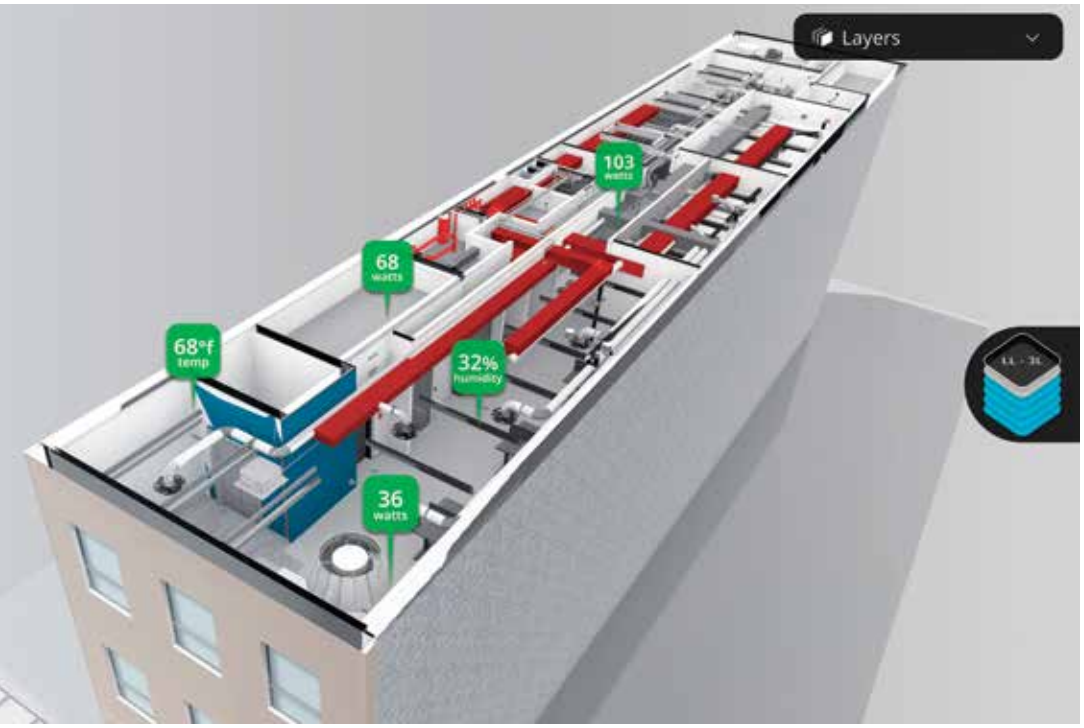
"We also use robots for stake out and existing condition surveys. The accuracy we get from the robot is better than GPS," Turner continues. "It's basically a robotic total station. We are getting measurements within a quarter inch from the robot. Another technology that has really advanced is ground penetrating radar that is used for underground utility location."

Collins explains that RuthrauffSauer has also been increasing its use of robotic devices.

"We are using robots for positioning hangars or anything that we have to attach to the structure," he says. "Robots have also been a tremendous aid for us in laying out the underground plumbing. It is hard to believe how much quicker that process has become. We have been using that at Mercy Hospital and we'll be using it at UPMC Presbyterian Tower."

Shane Zysk explains that the pace of technology advancement has made the newest technology more accessible. That, in turn, hastens adoption.

"Almost everyone has an auto level today and most have a basic mechanical total station. Robotic total stations are becoming more commonplace because of the flexibility one gives. A robotic station gives the opportunity for a one-person crew to do more than one job," Zysk says. "There has been a maturation of the equipment marketplace. Scanners that used to be $80,000 to $100,000 have come down to $40,000. That's still an investment but if you're talking about doing renovations of any scale that's a game changer to have on your team."



A virtual twin model can be paired with devices monitoring the construction to improve safety and the operation of the facility after work is completed. Image of 3512 Fifth Avenue by Ursa Leo.

Ray Volpatt thought one adaptation of the gaming technology he was investigating could be a game changer for the safety of his job sites. Using the intelligence collected and communicated by smart phones, workers on construction sites could be tracked and alerted to hazardous conditions or locations where there was potential for accidents. The software also gave Volpatt Construction's management information about the conditions on the job site that could be problematic for their subs and suppliers or their client.

"Every employee of Volpatt Construction on a job site is wearing a device that detect falls, potential falls, location, ambient noise, ambient light, among other information. We can see where an employee was in case there is an incident. An alert could be sent that noise levels are too high. Near misses of falls get detected. And I get reports the next day that tell me about the activity," Volpatt explains.

Workers wear Caterpillar phones that can interpret the motion of the wearer from three axes and tracks when the phone was positioned in a way that indicated a 70-, 80-, or 90-percent chance of a fall. Volpatt's supervision team can investigate the near fall to determine if it was caused by conditions and move to mitigate any risks involved. Asked how he achieved adoption of the devices in the field, Volpatt laughs.

"I wanted to implement it across the entire company. I have some workers that just won't wear it because they think they are being tracked and, in some respects, they are," he admits.

"The younger workers had no problem with the adoption. I had one person say, 'if I'm 900 feet away from someone who falls, the notification could be a matter of life-and-death or loss of limb'. Some workers were a little reluctant but did it anyway. I had to assure them that the purpose of these is for safety and safety only. It was up to me to prove that I wasn't going to use a safety tool to punish them."

Volpatt intends to use additional wearables to enhance the first steps his crews have taken in job site safety technology. He is evaluating vendors and expects for adoption of more field safety devices this year.

Safety was the motivating factor behind Ferry Electric's development of an app a few years ago that drove a daily safety message to the field worker. In addition to the messaging, Ferry Electric used the app to promote safety training and best practice reminders, offering free tools and other incentives. The app was a success but fell out of use when there were software problems just before the pandemic started.

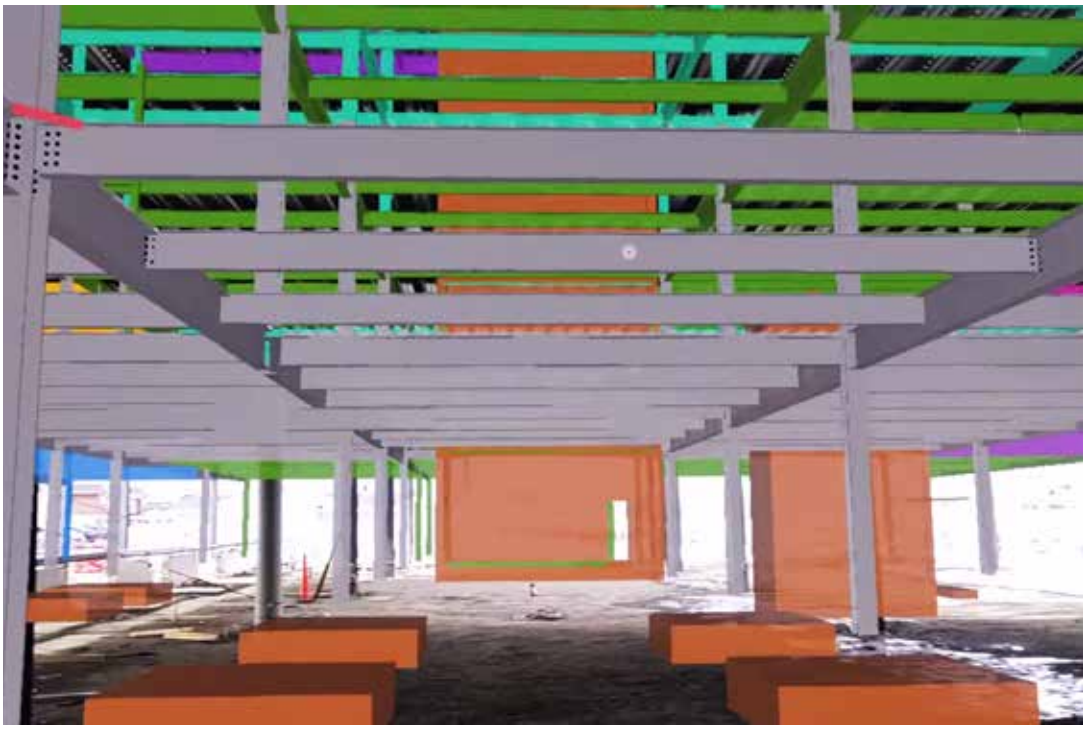
"We had a good safety record and we saw real reduction in the types of minor incidents – cut fingers or something in a worker's eye – that we wanted to tackle. We now have a team rebuilding that app from the ground up to be launched in the next couple of months," says Ferry. "If you look at business studies, when you have an employee who is engaged with the company, and understands its values, the employee's appreciation of the work increases. Customer satisfaction increases. Safety performance and efficiency improve. Every metric you can measure improves."

"The traditional model of hiring more workers during peak season means that when a new worker comes to one of our jobs, they have never met Jim Ferry," he continues. "They have no idea what I stand for. They know what the last contractor they worked for said was important. I want employees to understand what Ferry Electric is and what's important to the company."

There may be some truth to the perception that every new thing comes to Pittsburgh later than the rest of the country, but there are some practical reasons why technology adoption has been slower for construction than other industries. Pittsburgh construction companies have survived in a market that does not offer rapid growth behind which misjudgments can be hidden. Business

owners are more conservative here and technology investment decisions are more deliberate. Pittsburgh has fewer mega projects than gateway cities. Large projects have traditionally been the testing ground for new technologies that require significant investment. Whatever may have slowed the pace of adoption before, it looks like the 2020s will be different. Zysk sees technology adoption as a bare necessity going forward.

"I am sure there are some small operations that are just winding down towards retirement and won't be investing in new technology, but if you own a legacy operation you are adopting new technology," he says. "It's not a question of 'if' anymore. It's what and when." BG



Rendered elements from the building information model can be superimposed upon current conditions using VR or AR devices. Image by Precision Laser.

Photo by Jim Cunningham Photography.

PROJECT PROFILE

ANSYS HALL

Steel is flying on the new Scaife Hall, the 85,000 square foot home for the College of Engineering and Mechanical Engineering that will complete the construction of a new engineering plaza in the southwest corner of Carnegie Mellon University's (CMU) campus. The centerpiece of this new engineering sub-campus is a relatively small new building, Ansys Hall, that was built in the unlikeliest of places on campus. Like many of CMU's projects, Ansys Hall, is the product of an individual's vision.

"Jim Garrett, who is now our provost, was the Dean of the College of Engineering at the time of our master plan. We had this 20-space parking lot [between Hamerschlag Hall and Porter Hall] and Jim asked us to put that parking lot in the master plan as a future building site," recalls Ralph Horgan, associate vice president of Campus Design and Facility Development (CDFD). "We did not think it was big enough, but we put a building site there. Several years later, Jim got a gift from Ansys. This is what usually happens here. A block on the master plan becomes a project when someone secures a gift."

Ansys Hall serves as a key connecting piece in the linear progression of what CMU calls the "maker space ecosystem." Scott Hall represents the nano scale of engineering and the newly renovated Hamerschlag Hall houses the student maker space. The activities in Ansys Hall bring maker space to the desktop, where engineering students can utilize simulation software to fabricate large-scale prototypes. In addition to this curricular connection, the location of Ansys Hall created an opportunity for the new building to be a key physical connection on campus.

"CMU realized that there were other buildings and projects that were going to be tacked on to our project that needed air handling as well and decided that we should upsize the air handler for Ansys Hall,' says John Wattick, project manager at Mosites Construction, the construction manager for Ansys Hall. "Then the facilities group came in with several other renovation projects that needed conditioned air on campus and suggested that we also tack that capacity on to the air handler that we were buying. We were working with three different engineers and two different architects from other projects to determine their loads and capacity so that the equipment could be included in Ansys."

Ansys Hall is an extraordinary connecting point, but CMU tends to look at all its buildings in that context. Given the scarcity of land and the rapid pace of technology change on campus, the


Photo by Jim Cunningham Photography.

university does not look at any construction as a stand-alone project.

"Anytime we go into the ground it's an opportunity to partner with other stakeholders, including our facilities management team, which carries on the maintenance and operations of buildings on the campus. When we get into the ground, we find old terra cotta pipe and outdated infrastructure, so it makes sense to explore opportunities to improve the utilities and infrastructure for the entire university," explains Jennifer McDowell, senior director of design and construction at CMU. "When we engage our internal stakeholders on a daily basis, we see it as an opportunity to advance the university."

CMU has adapted its procurement process to accommodate its own collaborative approach to capital projects, bringing the design and construction teams on board as early as the programming stage. For Ansys Hall, Bohlin Cywinski Jackson (BCJ) and Mosites Construction were selected after a qualifications-based process. Horgan emphasizes that his team places a high value on the people that the competing firms brings to the table for any project. McDowell notes that for Ansys Hall, Mosites was forward-thinking in its approach and raised several issues that became challenges during the project.

Wattick says that one of the first challenges was a byproduct of the desire to optimize Ansys Hall's mechanical and electrical systems. To advance the project towards the original completion schedule of the 2019 fall semester, Ansys Hall was going to have to be a fast-track delivery method.

"We mobilized in December of 2017. There was a multi-phase release of documents. CMU added a basement and an additional level to the original scope, but we had to hold our completion date," says Wattick. "The design team needed more time. We needed more time, so we came up with the revised drawing release schedule where we got a foundation package, then the structural package, and then the fit out.

"That was challenge number one. We were constructing foundations, but we did not have a full structural package yet for what we were supporting. Later, there were architectural details that impacted the structure but were part of the third release after the structure was under construction. One of the biggest challenges was the logistical coordination of the design during those phases. Another big challenge of the project was the site. We were landlocked on three sides. Really it was four sides, but we had an access road that CMU was gracious enough to allow us to close that was the only access to the site from Frew Street."

The early coordination set the tone for the project, says Kent Suhrbier, principal at BCJ.

"It took a team approach. The changes would come up and everyone would roll up their sleeves and figure out what to do," Suhrbier says. "We tried to create a baseline, but the baseline kept moving. We had to remain agile and adapt to what the process brought. CMU was making good long-term decisions, but they had short-term impacts on the project. We had to come in with ideas and then work with Mosites to make them happen."

The long-term decisions arose out of the rapid expansion of the new technologies being studied and researched at the College of Engineering. This expansion of curriculum drove construction of

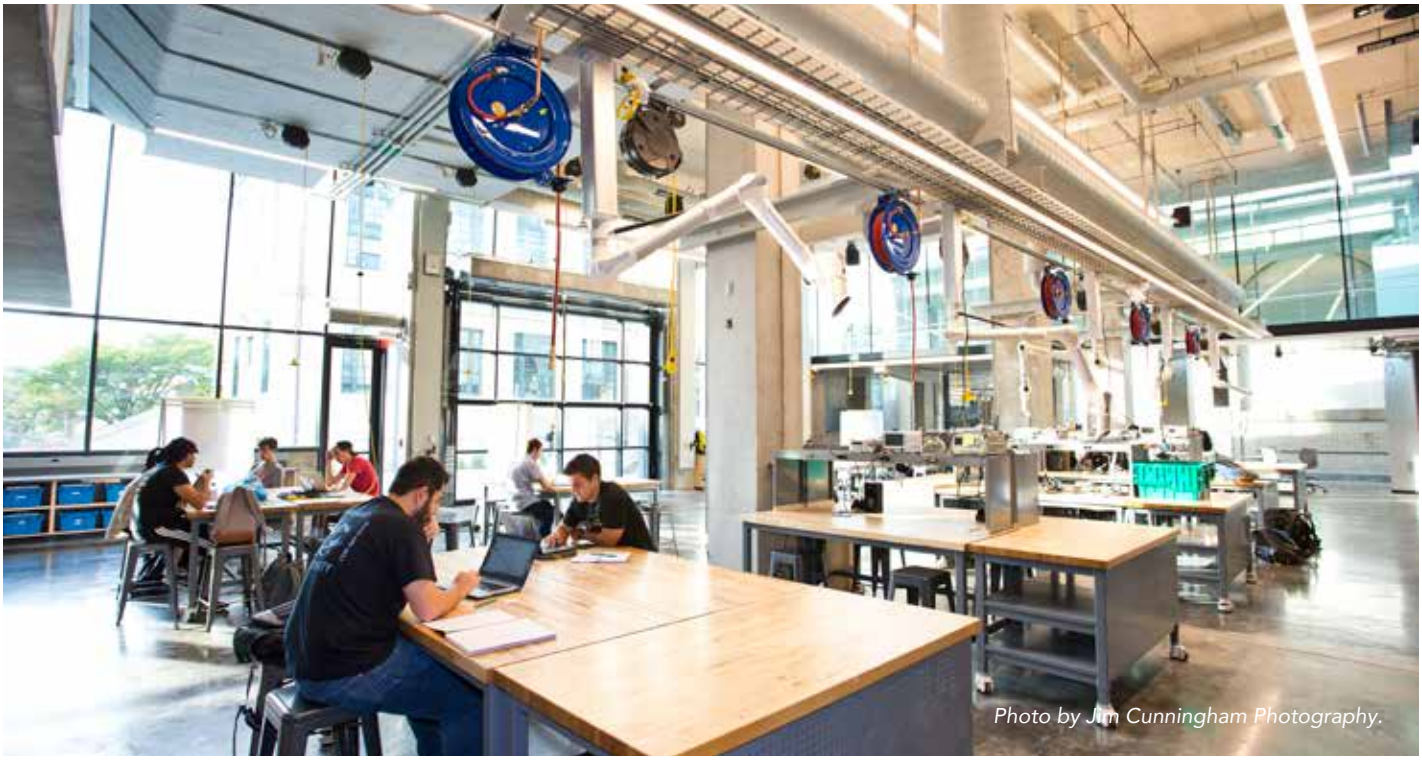


Photo by Jim Cunningham Photography.

new buildings – Scott, Ansys, and Scaife – and major renovations at Hamerschlag Hall. It meant an influx of three new buildings into a part of campus that included the iconic Henry Hornbostel buildings, but that part of campus was something of a back alley or back door. The new construction provided an opportunity to reimagine how the engineering quad would look and function. It also presented the difficult challenge of integrating modern buildings into a part of campus that many Tartan alumni might regard as sacred.

"That wasn't the back end of campus when Hornbostel designed it. He had a vision for Porter Hall, which involved a fountain and a tower. That end was originally supposed to be more of an entrance, but over time it turned into the campus loading dock," Suhrbier explains. "Part of the opportunity with putting Ansys in a place where a building doesn't really belong was to create a gateway, an entrance. CMU could have put a bigger building there, but the owner made a specific decision to pull the building back, as they had with Scott Hall. That was a decision that paid respect to Hamerschlag Hall."

"We did not want it to obscure the million-dollar view of Hamerschlag. We wanted Ansys Hall to be almost invisible from the mall," says Horgan. "We want contemporary buildings, but they have to be related to the context of the campus. We talk about buff brick, but Hornbostel used more than 20 different patterns of buff brick on the campus. What is contextual? What is contemporary?"

"Very early in conceptual and schematic design we worked to maintain the view corridor," says Patricia Culley, associate principal and project architect for BCJ. "We wanted to maintain the massing of the buildings down the side of the mall. We wanted to continue the massing that Hornbostel had already established with Baker and Porter."

Suhrbier notes that Hornbostel's contemporaries viewed him as a subversive, even though his work is considered traditional today. Suhrbier says that the team approached Ansys Hall's design by adopting that subversive mindset, seeking to evolve the "rules" that Hornbostel's century-old buildings established. Culley explains that the application of modern materials and methods created details that show how Ansys Hall is a product of its own time, all while integrating into the architecture of the surrounding buildings. The building's systems also reflect its time and place in energy efficiency and sustainability. Ansys Hall is LEED Gold certified.

"The reason that Ansys looks and feels like a contemporary building, even though it uses some of the same coloring and materials, is because of the details and how those materials come together," she says. "The bricks are framing double-height modern windows that are similar in proportion to the Porter wing or to Hamerschlag but are detailed in a way that is more contemporary. The details are how we pull it into the 21st century. We used a reveal, where in the past we might have used a molding. There are deep sunshades on the windows that are helping the building to perform better."

"In lieu of the cast roof tiles or wooden soffit that Hornbostel used, we did a modern interpretation by using similar colors, similar hierarchy of where the elements fit in the façade using modern materials," Culley continues. "Rather than using a simple metal roof and soffit we put a lot of effort into the detailing

similar to what Hornbostel put into patterns on the tiles, even though they were up high and would not be seen."

Culley and Suhrbier both credit Mosites and the specialty contractors for enabling the attention to detail. Mosites built numerous mockups to verify the constructability and cost of the details, as did the masonry, glazing, and roofing contractors.

"You can see the level of craft in the finished product," Culley says. "It was a result of the tradespeople wanting to understand the design intent. They wanted to get it right and set up the time to do the mockup and the coordination."

The emphasis on integrating Ansys Hall into CMU's surrounding architecture went beyond the aesthetic. CMU insisted on using the construction of Ansys Hall to provide access from the mall to Hamerschlag Drive some 50 feet below. The final design created connections to buildings and pedestrian access at seven different points, all of which were at different elevations.

"It extended universal access. Scott Hall connects to Hamerschlag, which connects to Ansys, which connects to Porter, and then you get back to the mall. Ansys allowed us to answer the question of how we can make connections for everybody," says McDowell. "The connections are not just internal. There is also the exterior access through the building to the mall. There's a beautiful corridor or bridge that bisects Ansys Hall and is surrounded by glass. Now we can bring the activity from inside of Ansys to the outside. The College of Engineering has been a big advocate for bringing the great things we're doing behind the walls to the campus community."

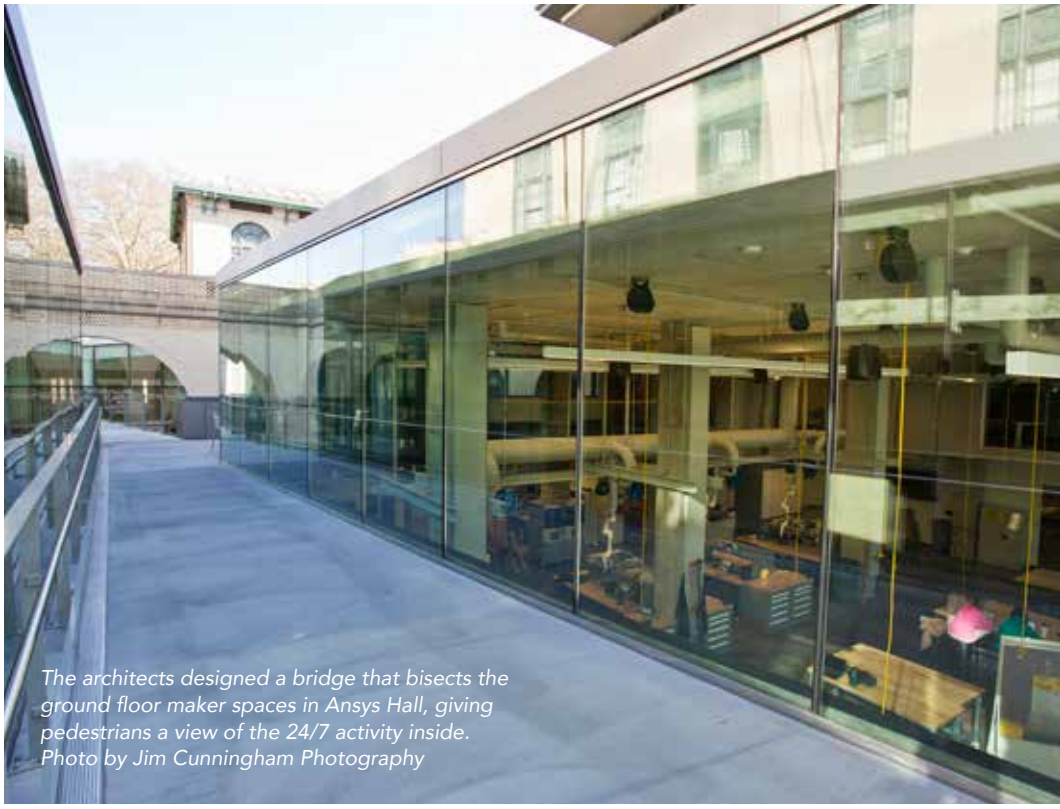
Achieving the connections and showcasing the maker space in Ansys created a host of fire and safety code issues. Building setbacks, accessibility standards, and fire safety had to be considered. CMU hired a code consultant to work closely with the Department of Permits, Licenses, and Inspections throughout. And, of course, the high level of physical integration created its own set of construction challenges.

"We were dealing with Hornbostel structures that were designed in the 1910s and 1920s and renovated throughout the years. None of the elevations matched so there was ramping on every floor," explains Wattick. "There were very low floor-to-floor clearances. Even if we didn't have to ramp a floor, there was a lot of mechanical coordination that had to happen. We were also working against existing buildings that were primarily faculty offices. We had the unpleasant job of telling the faculty

that they were going to lose their view during construction. We had to put foam infills in the buildings to help with noise mitigation."

"There were constant design modifications either due to existing conditions being uncovered or understanding better how the space would function for the engineering school. And of course, the site was always a challenge. How do you stack trades on a site that only allows you to be linear?" Wattick continues. "The logistic challenge was managing construction while there was a total of five spaces that were at different stages of design during construction."

Ansys Hall opened for classes and faculty occupancy in time for the fall 2019 semester. What returning students and faculty found was a centerpiece to the new engineering plaza. While mostly obscured from the main campus, Ansys Hall stands



The architects designed a bridge that bisects the ground floor maker spaces in Ansys Hall, giving pedestrians a view of the 24/7 activity inside. Photo by Jim Cunningham Photography


ANSYS Hall


Porter Hall CEE Renovation


Jared L. Cohon University Center

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Forbes & Beeler Residence Hall

out like the prow of a ship – especially at night – when viewed from across Panther Hollow.

"Ansys Hall helped activate that end of campus and improved accessibility. We didn't have universal access to all those buildings so Ansys now creates opportunities for everyone to enjoy that end of campus," says McDowell.

"It felt like what we built was a very elaborate connecting walkway," laughs Wattick. "It's such a good-looking building. It's a shame that it's sort of a tucked away gem."

Both Culley and Suhrbier are CMU graduates and have taught at the School of Architecture. They express pride in the project and in reviving Hornbostel's plans for a portion of campus from which world-changing innovation is emerging.

"We're very proud of it. Not only is Ansys Hall a beautiful building but we're proud of the program that we were able to accommodate because of the way the building is designed," Culley concludes. "Ansys is at the bleeding edge of what is being done there." BG

PROJECT TEAM

Mosites Construction	General Contractor
Carnegie Mellon University	Owner
Bohlin Cywinski Jackson	Architect
Barber & Hoffman	Structural Consulting Engineer
Buro Happold	Mechanical/Electrical Consulting Engineer
EMCOR/Scalise	HVAC
Ruthrauff|Sauer	Plumbing
Ferry Electric	Electrical
Preferred Fire Protection	Fire Protection
Maccabee Industries	Steel Fabrication
Century Steel Erection	Steel Erection
J. J. Morris & Sons	Drywall and Framing
Phoenix Roofing	Roofing and Sheet Metal
Franco Masonry	Masonry
D-M Products	Glass and Glazing
Fantin Flooring	Ceramic Tile
Wright Commercial Floors	Carpet and Vinyl Flooring
Palumbo Landscaping	Landscaping

Photo by Jim Cunningham Photography.

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FIRM PROFILE

DAGOSTINO ELECTRONIC SERVICES, INC.

When Bob Dagostino was a child, he often spent Saturdays at the Buhl Planetarium on Pittsburgh's North Side. There, he marveled at the wondrous displays—seeing, touching, and learning about the fascinating technology before him. This sense of wonder fueled his interest in technology and electronics. That spark would ignite a hobby, a career, and, finally, a full-fledged company.

Today, Bob Dagostino is founder and president of Dagostino Electronic Services (DES), a full-service technology integrator in Pittsburgh. With its headquarters at a converted Pittsburgh public school building and about 120 people on staff, DES creates customized solutions involving technological needs and applications for all types of businesses. Like the technology that it works with, DES has grown, changed, and evolved throughout the years.

In its early days, Dagostino Electronic Services provided infrastructure and wiring needs to set up telephone systems. That was in the 1970s, and, needless to say, technology and the ways that people communicate have come a long way.

Soon after, computers, in all their bulk, began to emerge. "When computers started to come around, they were pretty much stand-alone devices," Dagostino recalls. "People were carrying disks to printers to print and things like that. So, networks became an essential need for any business to function."

DES began to work on creating networks for businesses, educational institutions, and other clients. In the late 1980s, DES teamed up with IBM and worked on creating a unified network for Carnegie Mellon University, allowing its students, faculty, and staff to connect.

As the years and decades passed, technology changed. The devices, systems, and gear that DES worked on would change too. But its focus on technology would not waiver.

"Our focus has always been in technology—how can we infuse technology into businesses to improve their business outcomes?" Dagostino says. "We were never just satisfied with doing the wires and pliers portion of it. We always had a desire to dig into the active electronics that hung on to the end of those wires, be it telephones, computers, or data switches."

DES's extensive portfolio of telecommunications and technology includes work with multimedia and digital signage, security and surveillance systems, communications channels, and much more. Today, DES stays on the leading edge of tech and technological developments that can improve business operations. This includes exploring and developing emerging technologies in cybersecurity, the Internet of Things, Power over Ethernet lighting, and even Li-Fi, a cutting-edge system that uses light to transmit data.

When working directly with technology and electronics, change is constant. In terms of tech, staying relevant isn't so much the issue, but staying on top of tech development is essential.

"My job is to stay on the forefront of those technologies. That's my passion," Dagostino says. "We love what we do here. The team that we've built over decades here has always had the mindset of what's next and how can we stay relevant in providing a great service for customers and keeping their organizations ahead of the curve."

The ongoing COVID-19 pandemic has reshaped and even deepened our relationship with technology. It has also emphasized connectivity, Dagostino says, and has led us to adopt measures like distance learning, telehealth, and remote conferencing.

"I feel that we moved probably a decade in a matter of a year and a half or two years in accepting that digital world that we now are living in," he says.

At the onset of the pandemic, the question on every company's mind suddenly became, how well can we connect from home? People also wondered if the same technologies used at work could now be available to use from home. In terms of companies and their relationship with technology, the pandemic has tested their readiness to be nimble and to adapt to remote and digital transformation. For many businesses, the pandemic-induced focus on connectivity underscores its necessity in the broader picture.

"When I grew up, if you were going to start a business it was all about location, location, location," Dagostino says. "That used to be what it was. And today it's more about connectivity."

In terms of locations for connectivity, Pittsburgh is an ideal city for a company like DES that is so focused on technology. As

Dagostino says, the region's rebranding and embrace of tech-sector jobs, services, and companies makes for an exciting time to be working with technology. What was once a steel town is now home to robotics, autonomous vehicles, and revolutionary medical therapies.

"We've evolved from the Industrial Revolution that made Pittsburgh what it was. Today, we are in a technology revolution," Dagostino says.

DES is proud to be the preferred technology provider of the Pittsburgh Steelers. One of the company's largest ongoing projects has been providing technology solutions and systems support for Heinz Field since 2000.

"We built the infrastructure necessary for that venue to have everything that they have now, like the fan experience of wireless access, to the hundreds of miles of cable necessary for broadcasting," Dagostino says.

A stadium is so much more than an open field surrounded by seats and cheering fans—beneath the surface, it's a technological marvel. It takes real technological precision and planning to enable ticketless entry, install some 900 Wi-Fi access points, connect broadcast cameras, and even permit viewers at home to see those digital yellow lines that appear across the field. For more than two decades, Dagostino says that DES "has done everything necessary to connect everything to everything" at Heinz Field.

When DES began working at Heinz Field, setting up networks was a priority. So, the team worked to install great lengths of fiber optics, copper wire, audio cables, and other network components – more than 240 miles of cabling ensure that the stadium's technology delivers a flawless gameday experience. Antennas, RFID tracking technology, and a bevy of other components would all be added in over time. And since technology never stands still, when new devices and capabilities come along, DES gets to work. Next up will be enabling stadium-wide 5G access.

Looking forward, Dagostino says that many businesses are focused on green initiatives and finding ways to optimize energy consumption. Just as pressing, analytics and data governance integral to building optimization - and many other fields - will be increasingly important. Increasingly more devices and processes will generate increasingly more data that can be harnessed for insight and analytics.

"Analytics is going to play a big part. To be able to consume all of that data we are going to be overwhelmed with it as humans," Dagostino says. "So, we need to rely on artificial intelligence and machine learning to be able to leverage all of that data and take out the noise and just get those key objectives that are important to our businesses."

With all that data, it will be important to help businesses develop a strategic technology plan to integrate "Internet of Things" sensors with operational and business optimization tools and to make data useful.

"To normalize the data that we're generating and to catalog it properly is critical to being able to parse that data and make intelligent decisions based upon that," Dagostino says.

Suffice it to say, there's still plenty to come in terms of technology that will further revolutionize companies' capabilities. The development of new technology isn't stopping. And, so it seems, neither is Bob Dagostino.

"As long as we are being challenged and we've got the people that we have and the relationships with customers and manufacturers and things, it's a lot of fun," Dagostino says. "People ask me when I'm going to retire, and I just tell them, 'When I stop having fun.'" BG

Bob Dagostino

Dagostino Electronic Services, Inc.

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LEGAL PERSPECTIVE

DESIGN-BUILD – THE OWNER'S DILEMMA

BY LISA M. WAMPLER AND MICHAEL F. MCKENNA

Design-build contracts (and their lesser utilized counterpart—engineering, procurement, and construction (EPC) contracts) are prevalent in the construction industry. Though far from a new contractual relationship, owners are increasingly choosing design-build contracts to reduce risks and costs. Here in Pennsylvania, design-build delivery is allowed, but for public construction, it is effectively prohibited by the Separations Act, which requires multiple prime contracts be awarded for plumbing, heating, ventilating and electrical work. Locally, Fluor Marine Corp. and Seton Hill are currently using the design-build delivery model with PJ Dick at the helm to implement the construction of their projects, Building A7 at Bettis Atomic Lab and the Canevin Hall renovation, respectively.

The design-build model is attractive to owners because they have a single point of contact to handle both the architectural and construction aspects of projects. All too often, however, owners fail to understand the various nuances of a design-build or EPC model that can bring unforeseen challenges that effect other members of the team, such as engineers and design professionals. Indeed, it is not uncommon for an owner to think that design-build is a panacea akin to a "no change order procurement." Lack of clarity—or even the inverse of owners trying to be overly detailed—can, and has, led to a growth in claims, and prudent owners would be wise to understand the potential dilemma that can come with using design-build.

Going Hard Dollar

As a basic issue, owners do not seem to understand how much control they lose on a project once it goes hard dollar. There comes a point on a design-build project when the owner and the design-builder sign a contract where the design-builder agrees to perform the work for a certain dollar amount. We refer to this as "going hard dollar." This is the ultimate handshake and the proverbial "meeting of the minds."

Owners need to understand how much control they give up at that point as it relates to the final nature of the project. At this point, the project is now in the hands of the design-builder. A frequent concern is that the owner and design-builder never truly set a firm understanding, so throughout the project, there remains a difference between what the owner wants and what the design-builder understands to be the scope of work. The owner may not have explicitly and/or appropriately communicated its wants and needs to the design-builder, or, just as common, the owner did not fully comprehend what it wanted for the project until it began to see more of the design coalesce. The owner will often continue to make changes to the design after going hard-dollar while simultaneously not appreciating the financial impacts associated with those changes.

The owner needs to know that the scope book will be used by the design-builder to determine what needs designing and the construction parameters. The design dilemma may begin when an owner fails to spell out its intent, wants, and needs in the scope book or in any preliminary design given to the design-builder. When there are later changes to the scope book or expressed design, it ultimately leads to the design-builder seeking a change order.

The Owner's Design Dilemma

A starting point for every owner is determining the scope of the work to be performed. While this is often done using a scope book in which the owner tells the design-builder what it wants to be performed, there normally is some initial modicum of design work needed to compile the scope book leaving the book with its own set of issues. The owner needs to know that the scope book will be used by the design-builder to determine what needs designing and the construction parameters. The design dilemma may begin when an owner fails to spell out its intent, wants, and needs in the scope book or in any preliminary design given to the design-builder. When there are later changes to the scope book or expressed design, it ultimately leads to the design-builder seeking a change order.

Most projects, however, cannot be sufficiently planned or detailed at a scope book stage or even until they are underway. This leads to an owner inevitably asserting an

all-too-common refrain to the design-builder that "you should have known that is what I meant" or "you should have known what I needed." This dialogue degrades into a dispute over the doctrine of contra proferentem (e.g., trying to hold the recipient's reasonable interpretation against the drafter of the scope document, e.g., the owner). Ultimately, the owner has a responsibility to plainly state what it needs. If the scope book has ambiguity and the design-builder reasonably interprets what the scope book/partial design calls for, then the owner loses. The owner has the legal burden to detail its needs, although owners seldom appreciate—or fully understand—this responsibility.

As noted, commonly as part of a design-build project's bid documents, an owner will also have some early design work done by a designer of its choosing. We have seen projects where an owner started out with only four sheets of plans. More typical, though, are situations in which an owner goes much further into the design process, even as far as "30 percent design drawings," then seeks a design-builder to bid on completing the drawings and engineering/constructing the project. But whether four sheets or 30 percent design drawings, they nonetheless present a liability.

This partial design certainly may help to define the scope of work, but owners do not recognize that there are also concomitant liability issues that attach. If these partial designs contain errors, then the owner will remain responsible in the same manner as it does in design-bid-build. Likewise, if the owner then asks for a scope of work that is not reflected in those partial designs or not otherwise defined in the scope book, it remains financially responsible.

Further, one of the principal advantages of design-build is to give design-builder teams the ability to use their ingenuity and creativity in developing design concepts. The more design the owner performs, the more it undercuts the ability of a design-builder to utilize this advantage. Experience has shown that owners do not typically appreciate this give-and-take "design dilemma." An owner makes significant choice in determining how much design work is done before awarding a contract to a design-builder. The less design that the owner does, the greater the chances the owner will need scope changes to get what it truly wants and needs. However, while the more design that the owner does could better define work scope, it can simultaneously decrease the benefit of shifting design responsibilities to the design-builder. This results in a tenuous balance to make sure the project is properly defined while not unwittingly taking on design risk or undermining the design-builder's ingenuity.

For example, on one project, a design-builder's engineer misinterpreted the owner's criteria for the forces that a bridge pier had to withstand in the event of a marine collision. The engineer wrongly calculated the force based on the stated collision design requirements. This led to an issue between the design-builder and its engineer in which the designer's errors and omissions policy would be responsible for payment to the contractor. Then, given that previous error, the engineer retained a leading bridge collision consultant. When it did, the bridge collision consultant advised that the owner's original collision

criteria contained in the design given to the contractor was improper as it did not meet necessary standards. The bridge collision consultant then gave the engineer the proper marine collision criteria. This change meant that the bridge pier design that was already increased in size/magnitude to accommodate the first error would now have to be significantly larger. Ultimately, while the design-builder was responsible for the first error caused by its engineer, the owner was responsible for the latter error due to the incorrect criteria in the initial materials given to the design-builder. The project continued to go downhill, leading to a mutually agreed-upon termination for convenience.

The above example is unfortunately not a rare occurrence. Owners are responsible for errors in the scope book or contained in any initial design drawings they provide to the design-builder.

The other side of the coin is just as common: when a dispute arises because an owner does not sufficiently detail its needs, or, during the course of the work, it makes scope changes, these too will inevitably lead to demands for additional compensation.

Other Owner Mistakes

Owner liability can also attach for a plethora of other reasons when parties find themselves in a dispute over design and execution. For example, liability can attach when an owner's own engineering consultant becomes too involved with the design review process. This can happen, for example, when the owner's engineering consultant makes changes to the design-builder's design or when the owner's consultant does not provide review and/or feedback that extends the time of project performance. Indeed, these issues can result in significant claims.

That said, design-build can be an effective procurement system if managed correctly, with risks properly shared, rather than shoved down to the contractor and designer. Design-build shifts the burden and responsibilities for the majority of design to the design-builder and its design team. This has significant benefits for project success, creative ingenuity, and financial mitigation. It also can be a timelier method of construction and can lead to economic growth, generally, by getting projects off and running more quickly. To reap these significant benefits, however, all parties—including owners—need to go into design-build arrangements with a better understanding of their roles and responsibilities and to provide clarity for expectations and project requirements without limiting ingenuity or overstepping into the design-builder's responsibilities. BG

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FINANCIAL PERSPECTIVE

THE CONFUSION RETURNS: NEW ACCOUNTING RULES BAFFLE SURETIES AND BANKERS

BY MICHAEL H. BRONDER, CPA, CFF

Surety guarantors – the insurance companies that bond the performance and payment of contractors – will tell you that they get almost as uncomfortable about the top of a boom as they do the bottom of a recession. In both cases, defaults and business failures tend to follow a couple of years later. While 2022 may not qualify as the top of a construction boom, there are conditions characterizing the market that are signaling caution to the surety companies.

"The market is ripe for too much work in light of the labor shortage, COVID vaccines, rising price of materials, and the supply chain complicating things," says Jay Black, principal, and vice president of surety at Seubert & Associates. "I spent a week talking to the top folks at the eight largest sureties and they are sensing that 2022 is going to provide ample opportunities for companies to over-grow. With all that said, the sureties are still looking forward to this year as another good one. I'm feeling bullish about this coming year."

"The potential backlog in terms of projects in Western Pennsylvania is phenomenal," notes Zach Mendelson, principal at EPIC Insurance Brokers and Consultants, and third vice president for the National Association of Surety Bond Producers. "From the surety's point of concern there is cautious optimism. No one is seeing large losses."

Performance and payment bonds are written by insurance companies that indemnify risk across all facets of business and life. Those companies profit from construction bonding in the same way that they do from life insurance or property/casualty insurance: by taking in premiums that exceed the amounts paid in claims and operating expenses. For construction bonding, that means assessing the risk of default by a contractor, either by failing to complete the project or failing to pay the subcontractors. This process of underwriting considers the macroeconomic factors that could increase the risk of claims – like recession or pandemic – and the microeconomic factors – such as the financial performance of the insured contractor or the projected profitability of the contractor's backlog – to determine the rate that the contractor will pay and the bonding capacity the contractor will have. The latter often determines how much work the contractor can pursue.

Insurers characterize market conditions as either soft, meaning rates are lower and capacity is available, or hard, meaning bonding capacity is more precious and expensive. In ideal circumstances, surety bonding would shift to a hard market about a year or so ahead of rougher economic times. In practice, insurers often tighten underwriting in response to the poorer economic conditions.

It was an overextension of soft surety market conditions at the end of the 20th century that resulted in a period of steep losses when construction defaults surged coincidental to several costly natural disasters and the 9/11 terrorist attacks. Following an unusually hard market in 2003 and 2004, surety loss ratios plummeted, remaining mostly below 20 percent through 2010s. As a result, surety bonding capacity has been readily available for most contractors for more than a decade. Coming into 2022, however, this extended period of surety market strength is being challenged by three uncertainties: volatile inflation, a severely disrupted supply chain, and a growing labor shortage.

Long-term observers of the construction industry expect that the unusual conditions present in today's market will lead to contractor losses and defaults at some point but are not concerned about that occurring in 2022.

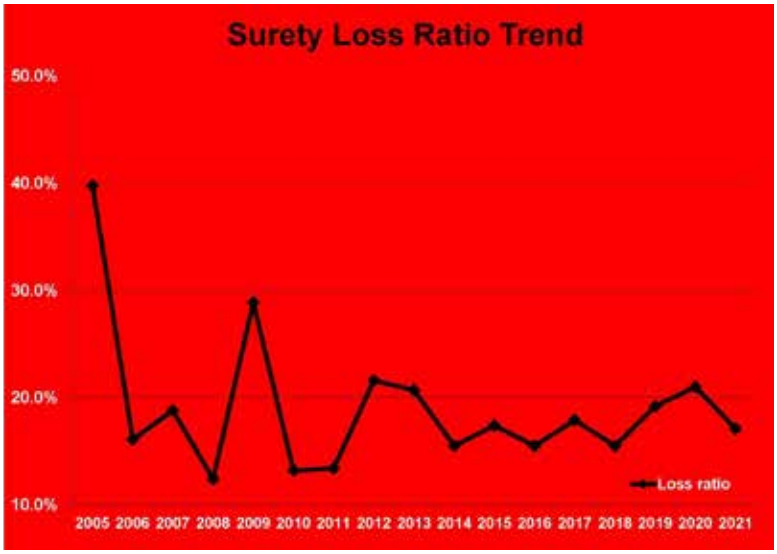
"What will eventually happen is that there will be defaults with subcontractors and smaller contractors," predicts Jim Bly, managing director for subcontractor default insurance and surety analysis for Alliant Insurance Services. "That will impact the reinsurance market and a lot of the sureties that are feeding business to reinsurers will start to lose capacity. But we're a long way away from that happening."

On the contrary, conditions in the construction surety market have attracted new players in recent years. By maintaining underwriting discipline since the 2004 losses, surety companies have kept losses well below levels that would threaten profitability, which has made construction more attractive to insurers. Bly reports that in 2022, Markel Insurance Company and Crum & Foster Insurance are ramping up surety bonding, offering programs up to $500 million. Those are only the latest insurers returning to construction surety, which has become reliably profitable for the industry's largest players, like Travelers Bond, Zurich, CNA, Chubb, and Liberty.

"Capacity and underwriting terms will remain favorable for the next 12 months," predicts Bly. "There is plenty of capacity in the market. The new players who entered the market in recent years have done well and the large insurers all had very strong years in 2021. The mood with sureties overall is good."

Virtually everyone associated with the surety market is clear about the reasons why the overall mood is good. A strong economic recovery, leading to solid backlogs, has been helpful, but the surety market would look decidedly different without the Paycheck Protection Plan (PPP) that was included in the CARES Act of 2020.

"I was watching It's a Wonderful Life as I do every year, and I couldn't help think of Paycheck Protection," chuckles Black. "The premise of the movie is what the world would be like if Jimmy Stewart's character wasn't born. What would the world



Source: Surety and Fidelity Association of America

look like today if we didn't have two rounds of PPP? Cash from PPP is still on the balance sheet. I think companies have been disciplined and managed their extra cash well. It has companies in pretty good shape."

"The conditions in 2020 had the potential to wreck financial statements but coming into this year we haven't seen that come to fruition because of PPP," agrees Mendelson.

"We are starting to see some increased losses from operations among subcontractors. They are having to deal with material cost escalations, and labor shortages, and challenging projects. There is enough capital now to absorb that," notes Bly, whose company maintains a credit database of over 2,500 specialty contractors nationwide. "Results for subs from operations overall did deteriorate slightly in 2021 but net income did not deteriorate because of PPP forgiveness, which provided a 20 or 30 percent lift to bottom line profits."

Alliant's national analysis of specialty contractors found that PPP proceeds made up an even larger percentage of net income before taxes, which jumped from an average of 7.5 percent in 2020 to 12.8 percent in 2021, even though revenues fell by nearly six percent in 2021. Liquidity, measured by working capital as a share of backlog, increased from 10 percent to 11.7 percent from 2019 to 2021. Owner's equity in the business remained steady at 15.5 percent. Alliant's analysis of Pittsburgh-area specialty contractors found that their net

income doubled from 2020 to 2021 on revenue growth of eight percent. One area of concern was the observation that profit margins shown on backlogs were lower than those on the income statements for 2021, suggesting that bids for work in 2022 may have been more aggressive.

Surety companies are buoyed by their clients' cash reserves and a year that begins with big backlogs and growing demand. Not surprising, however, few surety professionals expect 2022 to be uneventful.

To begin with, changes in generally accepted accounting practices (GAAP) for recognizing revenue and accounts receivable (especially including retention) have created confusion for those, like surety providers, that must analyze the financial statements of contractors (see January/February BreakingGround page 52.) GAAP revisions have not been adopted by all contractors, and many sureties are untrained as to how the changes reflect the client's finances.

"I am seeing a lot of confusion about the financial reporting. Sureties are getting financial reporting that is all over the map," report Michael Bronder, CPA, president of Bronder & Company. "It's not done consistent with the way it's been done in the past, so the sureties are having a terrible time analyzing the financial statements. Not all accountants are following the new standards. When sureties are confused, they tend to pull back a little bit."

In the context of a soft market, pulling "back a little bit" is likely to translate to more questions being asked than in previous years. For now, at least, insurers are not going to reduce capacity. But the confusion in accounting is not the only cause for caution.

Inflation and supply chain disruption have gone hand-in-hand since early 2021. For surety companies, the concern is that those two factors present risks to the timely completion of projects, and ultimately to the financial health of contractors. Firms that won bids without properly accounting for price escalation – or worse, those that planned to buy projects out at lower prices after the bid – are unlikely to build the project for the promised price. In small doses, that is a recipe for reduced profits or small losses. On a large, complicated project, such an approach could lead to contractor default or business failure.

Likewise, failing to plan or account for the exaggerated delivery times with protective contract language will lead to consequences for contractors. Project delays have become commonplace. According to the Associated General Contractors' 2022 Outlook Survey of its member general contractors, 72 percent of firms say projects are currently taking longer than expected, but only 44 percent say they are putting longer completion times in bids and contracts.

Labor has been in short supply for construction since the recovery from the Great Recession because of demographics and long-term trends in recruitment. Two years into the pandemic, construction is experiencing the same "great resignation" as other industries. With insufficient skilled labor and supervision, productivity has declined. That adds to the problems that inflation and supply breakdowns have caused project delivery.

"A fourth factor this year is lenders. We're spending more time with lenders and investors than normal," says Mendelson. "There has been more circling back by those entities financing private projects to the sureties to verify that the project is bonded."

For contractors with established surety relationships, this heightened level of caution may not be recognizable in their reviews for 2021 and 2022; however, behind the scenes, surety providers are looking closer at leading indicators, as are the professionals serving the financial interests of the industry.

"The lawyers we work with say they have spent more time reviewing contracts in the last 18 months than they remember spending in the last 18 years," says Mendelson. "Force majeure is something I remember learning 30 years ago starting out in the industry. It rarely came up in conversations until the last couple of years. Now, not a week goes by that we don't talk about it in terms of schedule."

It may seem like heightened caution is unfounded coming into a year with the promise of so much construction, but that is probably good for the industry. Surety companies play an important role in the construction industry, one that brings certainty about completion to owners and developers. Given the extreme uncertainty of the past two years, and the justifiable concerns about prices and schedules, a little extra caution may keep the industry from getting too far out over the tips of its skis. There is little or no evidence that the heightened caution is going to restrict capacity, so surety companies are seeking more assurance that the capacity will be utilized by contractors that are prepared for market conditions. And caution is not the same as pessimism.

"We saw increased bid activity in 2021. We wrote 6,500 bid bonds in 2021. The prior year it was 6,000," says Black. "And this year is off to a good start. The work is out there." BG

TREND TO WATCH

FRONT ROW SEATS FOR THE WHOLE TEAM: HOW REAL-TIME RENDERING CAN BENEFIT OWNERS, DEVELOPERS, AND CONTRACTORS

BY AARON PERELSTEIN, AIA LEED-GA

Ever since the advent of Building Information Modeling (BIM) technology over the last few decades, the relationship between architects, developers, and contractors has not achieved the cohesion promised by the marketing. Each party reviews and analyzes technical drawings in a unique way – architects are concerned with the aesthetics of a design decision, engineers are more concerned with functionality, and contractors are concerned with logistics. These perspectives are equally important in any project because of their differences. It takes an architect's vision to create an appealing scope-appropriate space, an engineer's expertise to ensure the feasibility of building systems, a contractor's skills to bring it into fruition, and an owner's drive to initiate the project in the first place. It is no surprise that these collaborators have developed unique perspectives to fulfill their specific roles. The disconnect in communication, then, is often more an issue of interpretation. Everyone may be looking at the same documents but interpreting them differently. So, how can project teams get on the same page and avoid those schedule delays and setbacks caused by miscommunication?

Real-Time Rendering

The missing piece in the project team puzzle is a common language to link the members together. Two-dimensional drawings that are most commonly seen on job sites have the potential for interpretation issues and fail to fulfill that role for those not accustomed to such technical standard. Meanwhile, three-dimensional models are becoming more accessible as real-time rendering gains ground with forward-thinking architecture firms. On the forefront of architectural design right now, this technology takes the form of a plugin linked to a BIM or CAD model. Programs like Enscape and Twinmotion generate highly detailed and accurate visual representations of the information provided by the models. The rendering is live – continuously updated based on changes made to the design – so designers can see the effects of their decisions in real time.

The resulting experience can be as simple or as detailed as the owner or architect intends. When collaborating internally, design teams at IKM Architecture often find that viewing a model in a simplified "white mode" is better suited to the early design phases. This highlights the size, shape, and configuration of a space which is ideal for project planning and design development without getting sidetracked by material selection. IKM has utilized real-time rendering in this capacity on most projects since 2018 and has been growing the utility ever since. But for the purposes of communicating with contractors, clients, and users, the model can be enhanced to appear more photorealistic with the addition of textures, accessories, and even people. The 3D model becomes a virtual environment where you can immerse yourself in a project before there is a shovel in the ground.

Because there is such a large amount of data included in BIM models which then gets fed into the real-time rendering plugin, the 3D renderings achieve a high level of accuracy. This allows for spaces and details to be designed to a minute degree. Sightlines, daylighting, materials, and more can easily be analyzed throughout the project. With the ability to view the rendering through the eyes of a user or just "fly" around the model, designers can experience the entire space from any perspective. When designing a children's hospital, for example, the height of the eyeline can be lowered to visualize the perspective of a child. Tight, complicated details that would be difficult to reach on a job site can be viewed easily in the rendering. Since the software is simply a display of the model, as construction documents are developed, any adjustments are reflected instantaneously.

When the rendering is ready to be shared with stakeholders, architects have options to export for convenient viewing on any device. An interactive 360 photo tour of the design can be created as well as a video with a predefined path through the space, or even just a panoramic photo set. As the pandemic changed the way we live over the last two years, home buyers have grown accustomed to viewing virtual tours instead of visiting homes in person. This method of exploring a space is now becoming readily accessible prior to construction as well. The whole project team – designers, consultants, contractors, owners, and users – can see the big picture together. The incorporation of real-time rendering into the design process may take slightly more time upfront for the design team to model context that may not be required for construction documents, but the 3D model offers a wealth of opportunities to assist the project down the line.

Bridging the Gap Between Owner's Vision and Architect's Design

The accessibility of real-time rendering is a major component of what makes this technology so beneficial for project teams. Designers have been building virtual models in BIM and CAD for years, but it is not always easy to convey the benefits to the owner clearly. Real-time rendering provides a translation of that existing model into a visual representation that anyone can view and interact with. It presents the building information to the owner, user, or contractor in a convenient, understandable way. This gives clients the freedom to collaborate with the architect on the vision of the project and removes the element of "imagining" the

The new Seneca Valley Aquatic Center as rendered in real time. Image by IKM Inc.

architect's perspective. Being able to see the space, look at materials, equipment layout, sightlines, etc. empowers the owner to have input on design decisions early in the project. There is no longer the risk of disappointment when the building has been constructed because everyone is on the same page from the beginning.

With the vast majority of meetings happening remotely in recent times, design teams at IKM have shifted the way they present 3D models to owners and users. The use of screensharing and personal devices during virtual meetings provides the opportunity for everyone involved to have a front row seat. Unlike in-person discussions where people in the back of the conference room can't always see the screen, now all participants have a shared experience because they are viewing the rendering at the same time. This creates a more democratic environment with increased user engagement and thorough feedback because people can relate to what they're seeing much more quickly than they can with technical drawings.

In the case of the new aquatic facility project at Seneca Valley School District, there was a desire for a visual connection

between the existing football stadium and the pool stands. The design team was able to fly over and take the position of a spectator to show the view through the window to the stadium beyond. It directly connected what the architects were saying to what the user was seeing in the moment, validating the benefits of such an investment, and boosting confidence in the design outcome.

The completed Seneca Valley Aquatic Center. Photo by Aaron Perelstein.

Sharing the Model with Stakeholders

Experiencing the 3D model is not just limited to user engagement meetings and design development. With the ability to output an interactive 360 tour generated with images from the real-time rendering plugin, the model can be viewed on lower-powered devices like smartphones and tablets. This makes it shareable to nearly anyone who is interested – owners, end users, possible tenants, donors, and so on. Just by sharing a link or posting the tour online, people can experience the excitement of walking through a project before seeing it in real life. There's nothing more exciting than being able to navigate around a virtual space on your own time and then text it to a friend to share the experience. Having that 360 tour conveniently available can

contribute to project support and fundraising by generating grassroots interest with the community and enthusiasm with stakeholders. The developer can see what an office space will look like, what the view from the window will be, how the building fits into the neighborhood, and utilize that visualization to secure tenants early. Now, people don't have to wait a year from breaking ground to finally see the building – they have the model at their fingertips throughout the process.

Avoiding Complications in the Construction Phase

While real-time rendering has been utilized mostly as a design tool up until now, it has current and future applications in the construction phase as well. Even before materials are ordered or contractors see technical drawings, the architect has the chance to walk through the building virtually and resolve design details that might be complicated in construction. Not only does this help the contractor's job run more smoothly, but it also saves time and money by uncovering questions before construction is in place, making solutions more flexible and minimizing change orders. Any conflicts that exist can be explored early on – designers can see where a duct might be protruding from a bulkhead in the model and avoid that moment when the construction schedule is held up because the project team is brainstorming solutions at the last minute.

By sharing the 3D model with contractors onsite, project teams can also reduce the back-and-forth between architects and builders often needed to clarify the design intent of technical drawings. Instead of relying solely on the interpretation of the documents, contractors have access to the rendering to instantaneously view the design vision from the job site and use their expertise to execute it. This added clarity is particularly useful in the case of labor shortages and the recent increase in unskilled labor. The benefits to coordination that real-time rendering provides throughout the project culminate to speed up construction schedules and avoid costly setbacks. The future of this technology integration into the construction phase is still in the early stages, but shows potential for significant advancements.

Accommodating Late-Stage Design Changes

The implementation of real-time rendering can add some steps on the architect's end, which may require time to apply detailed information to the 3D model upfront. This extra effort is often made up for in accelerated design and construction schedules. The speed and quality with which architects can showcase various design ideas shortens the overall exploration process and ultimately reduces documentation time. When projects are met with material shortages and delays, it becomes easy to swap out design elements and compare substitution options within the rendering. Many late-stage decisions can be agreed upon and validated quickly by viewing the results virtually before making purchases. Once the designers have completed the process of modeling an existing building in its entirety, the project team is prepared for the possibility of scope shifts or design adjustments. Incorporating this step early in the planning process allows the real-time rendering to develop in line with the needs of the client and assume multiple roles throughout the project: design tool, method of communication, supplemental construction documents, fundraising resource, and so on.

Conclusion

The advantages of real-time rendering technology are best represented in the opportunity for owners and project teams to communicate effectively and plan accordingly. The level of photorealism that can be achieved encourages all parties to participate in the design process, from client and end user to contractor and engineer. By sharing a 360 tour with the community, the rendering can generate local excitement and support, and act as a tool for fundraising. Visualizing alternative materials, design elements, and interior finishes virtually throughout the construction phase saves time and money in solving unavoidable challenges. And when this project has come to fruition, the complete building model is already available for the next one – no need to start from scratch. BG

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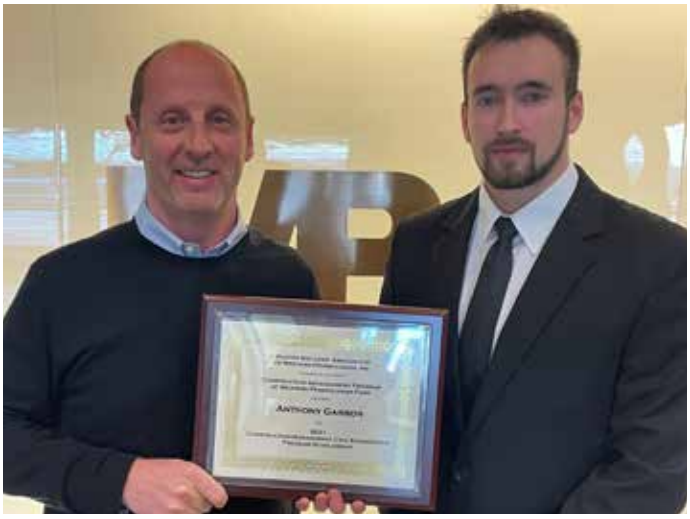
INDUSTRY & COMMUNITY NEWS



The MBA and the Construction Advancement Program (CAP) awarded two scholarships, worth $15,000, at the MBA's Annual Membership Meeting on January 22. The University of Pittsburgh Construction Management/Civil Engineering student scholarship awardees were Gary Sciulli and Anthony Gansor. Pictured are TEDCO's Jim Frantz, chair of the MBA Education Committee, (left) with Anthony Gansor.

Mascaro's Rick Bowers, chair of the MBA Risk Management Committee, (left) with 2021 MBA Safety Scholarship winner Ty Kent, a student at Slippery Rock University.

With many in need during the winter months, Mascaro participated in five community initiatives for a "Season of Giving." Donations went to the Greater Pittsburgh Food Bank, Toys for Tots, Salvation Army, New Hope Church, and Sweats for Vets.

In support of the American Heart Association and Heart Health Month, Mascaro held a "Red Day" at its office and select job sites. Team members were encouraged to wear red and participate in free blood pressure screenings and education sessions that were administered by a local pharmacist.

(From left) Chris Haupt from DLA+ Architecture, John Mascaro, JT Thomas, Pittsburgh Steeler alumnus; National Aviary Board Trustee Michael Mascaro, Pittsburgh Steeler alumni Craig Bingham from All Systems Inc., and Matt Spaeth at the Gentleman's Night Out at the North Shore. The evening, which was hosted by Mascaro Construction, raised $193,000 for the National Aviary.

(From left) Mike Dunleavy (retired), Thomas McIntyre, and Mike Varholla from IBEW Local 5.

Bob Ward (left) and John Jordan from McKamish.

(From left) Rycon's John Sabatos and Carl Tipton, winner of the 2021 MBA Safety Champion award, with Steven Massaro from Massaro Corporation.

(From left) Matt Diersen from Midland Architecture, DiMarco Construction's Matt Bowers, Scott Wardle, Phil DiMarco, Patrick Duymic, Christina DiMarco, Domenic DiMarco, and Angela Derosa.

MBA's Dave Daquelente (left) with Mobile Medical's Chelsea Klutz, and Anthony Romano.

(From left) RM Creative's Kelly Brown, Lauren Pataky from Mannington, AHN's Michelle Resick, and Dan Engen from DRAW Collective.

(From left) NEXT Architecture's Julia Ruggiero, Tony Kosec, Erik Capra, and Nicholas Miller, with Jennifer Landau and Jamison Vernallis from Landau Building Co.

(From left) Mark Minoski from Duquesne University, Susan Jansen from DRS Architects, PJ Dick's Kevin Ludwick, Duquesne's Rod Dobish, and Mike Scerbo.

(From left) MCF's Alan Hohfelder, MBA Building Excellence Awards judge Bill Bates, Mascaro's Bill Rost, CMU's Utkarsh Ghildyal, and Sanela Reboholz from R3A.

(From left) Baker Tilly's Brian Kasselen, with Michael Klein and Jim Kutz from McNees Wallace & Nurick.

(From left) Rycon's Jeff Redman, Amy Konieczka, Toni Peltz, and Phil Linton.

(From left) Tom Nebel, Tina Stumph, and DJ McClary from Tri-State Signs & Reprographics.

(From left) Tracey Case-Dodds and Rachel Sweetland from AE Works, with Liz Gamelier from Trans Associates.

(From left) Rich Yohe from Easley & Rivers, PJ Dick's Eric Pascucci, and JR Reed from Reed Building Supply.

(From left) Shawn Wolf and Anne Osborn from MSA, with the MBA's Bob McCall.

(From left) Tim Chesleigh, Doug Martin, and Sam McPherson from the Eastern Regional Council of Carpenters.

(From left) Lindsay Andrews, Abby Blend, Jennifer Horvath, and Kathleen Carpenter from The Design Group.

AWARDS & CONTRACTS

Landry's Inc. selected **A. Martini & Co.** to build out its Del Frisco's Steak House at the Union Trust Building. Aria Group Architects designed the 10,000 square foot renovation to three levels.

Allegheny Health Network awarded construction management contracts to **A. Martini & Co.** for three renovation projects. **A. Martini & Co.** will manage the conversion of 7,500 square feet at Suburban General Hospital to urgent care in Bellevue, the multi-year hospital-wide upgrade of fire protection at West Penn Hospital, and access control upgrades at Allegheny Valley Hospital in Natrona Heights.

Mosites Construction is building a three-story, 40,000 square foot new monastery for the sisters of the Divinity of the Theotokos in Jefferson Township, outside Saxonburg, PA. The architect is MacLachlan Cornelius & Filoni Architects.

Uhl Construction was awarded a contract to furnish the pre-engineered structure for the new public works facility at the Borough of Crafton. Gateway Engineers designed the 12,500 square foot facility.

Shannon Construction Co. is doing the tenant improvements for CONSOL Energy's new office at 275 Technology Drive in Southpointe. The 30,000 square foot headquarters was designed by Strada Architecture.

Duquesne University selected **Volpatt Construction** to construct the Rangos Cadaver Laboratory. WTW Architects designed the million-dollar renovation.

Volpatt Construction was selected as contractor for the $1.9 million renovation of the Mellon Institute Cai Lab and Kuang Lab for Carnegie Mellon University. The architect is Stantec.

Turner Construction's Interiors and Special Projects Group is building out the $1.5 million space for Incline Equity on the 24th floor of EQT Plaza. MossArchitects is the architect for the 13,000 square foot space.

Pittsburgh Water and Sewer Authority awarded **Kokosing Industrial** a $2.33 million contract for the general trades portion of the Herron Hill Reservoir and Sodium Hypochlorite Building in Robert E. Williams Park.

Rycon was the successful low bidder for the construction of a $127 million, 1.5 million square foot Pittsburgh Airport Multi-Modal Complex consisting of a new five-story multi-level parking garage including rental car parking, customer service areas, quick turnaround facilities and ready/return, and 3,500 public parking spaces.

Rycon's Building Group was awarded a GMP contract to renovate University of Pittsburgh's Litchfield Eateries. This $11.6 million, 57,000 square foot dining facility will be built in phases over two consecutive summer breaks.

The lowest of nine bidders, **Rycon's** Building Group was awarded a single prime contract for the construction of the new $12.4 million, 32,300 square foot Brooke County Judicial Center.

Raising Cane's awarded **Rycon's** Special Projects Group a $1.8 million renovation of their restaurant located in Oceanside, CA.

In San Diego, CA, **Rycon's** Special Projects Group is completing a 6,000 square foot fit-out of The Bridge Restaurant.

A ground-up Shoot Point Blank is being constructed by **Rycon's** Special Projects Group. This $3.1 million, indoor gun range will be located across from The Mall at Robinson.

Rycon's Special Projects Group is fitting-out a 2,500 square foot space at The Terminal for Mayweather Boxing & Fitness.

Rycon's Special Projects Group was awarded an American Eagle Aerie store in Simpsonville, KY.

In the past year, U-Haul awarded **Rycon** 11 new storage facility projects totaling $113 million. The most recent locations are Ocala, FL and Oakwood, GA.

Repeat client AutoNation continues to award **Rycon** new construction and renovation projects totaling $46.2 million. The most recent project award in Buford, GA.

Rycon was awarded a $1.2 million 5,200 square foot renovation of the Pepper Pike Police Station in Ohio.

Rycon is responsible for building-out a 120,000 square foot industrial facility into Radix's new state-of-the-art headquarters. Previously occupying two separate manufacturing facilities, Radix is going to consolidate their space into one building in Glenwillow, OH.

In El Paso, TX **Rycon** is completing a $3.9 million project for Fresenius Medical Care.

Rycon was awarded a general trades contract for the Plymouth Township Municipal Campus in Plymouth Township, PA. This $22.3 million project consists of a 43,000 square foot, one-story renovation of the municipal building/police department and a 7,000 square foot renovation of the public works building.

PJ Dick Mid-Atlantic negotiated the Phase III work at Cathedral Village with Presbyterian Senior Living. The project consists of exterior renovation of two residence buildings at the front of the property, exterior renovations to the main entrance building, along with new enhanced vehicular access and bus drop off area for residents.

Mascaro Construction subcontracted **PJ Dick's** Self-Perform Group (SPG2) for the concrete excavation and shoring

associated with the construction of Carnegie Mellon University's Highmark Health, Wellness, and Athletics Center.

PJ Dick Industrial is providing subcontractor services to Black & Veatch for site work and foundations for Eight Points Wind Farm in New York for 25 wind turbines.

Massaro Corporation was awarded $2.6 million University of Pittsburgh Thaw Hall renovations.

Massaro Corporation was awarded $2 million University of Pittsburgh Bellefield Hall renovations.

Massaro Corporation was awarded the $500,000 University of Pittsburgh Alumni Hall ADA entrance renovations.

Massaro Corporation was awarded $1.6 million University of Pittsburgh Litchfield Hall renovations.

Allegheny Health Network awarded **Massaro Corporation** the $1.3 million AHN Canonsburg Hospital air handler unit replacement.

Allegheny Health Network selected **Massaro Corporation** as construction manager for its $9 million AHN St. Vincent Hospital CDU and AC3 in Erie, PA.

Gruppo Fanti selected **Massaro Corporation** as contractor for $6 million in renovations to its facilities in Weirton, WV.

Millcreek Township School District selected **Massaro CM Services** as CM-Agent for its $20 million renovation program. The architect is HRLC Architects, LLC

Landau Building Company will be replacing the existing PET CT with a new PET-CT on the first floor of Hillman Cancer Center. This 2,900 square foot project for UPMC Magee is a partial reconfiguration of the imaging department to improve patient experience and staff services. Work will begin in June 2022. RM Creative is the architect.

Landau Building Company will soon begin interior finish upgrades in the Pre-OP and PACU spaces within UPMC Magee Women's Hospital. The project will take place during off hours and the work will be complete in 11 weeks. Landau will also be the construction manager of the UPMC Magee Surgical Suite Nurse Call Upgrades project.

Landau Building Company is the construction manager for renovations of the studio at Andrew Carnegie Free Library & Music Hall. Work is scheduled for completion in March 2022. The Design Alliance is the architect.

Mascaro is fitting out a 7,000 square foot shell space at the Steamfitters' Meeting Hall to accommodate the Allegheny Health Network Zelienople Clinic. The outpatient clinic will hold physical therapy, orthopedics, primary care, and x-ray imaging services.

At the UPMC Hillman Cancer Center, **Mascaro** is renovating the entire second floor including the clinic, treatment, support, and office areas.

The National Aviary awarded a contract to **Mascaro** for renovations of the eagle exhibit. The renovations include the removal of two existing habitats and installing new foundations and steel shell for new exhibits.

Facility Support Services (FSS) was recently awarded the $4.1 million project for the exterior envelope and interior renovation of 10,000 square feet of shell space for future tenant fit out at Buildings W13 and W15 located on the Fairfax County's Historic Workhouse Campus in Lorton, VA. The existing buildings are considered historical, and the Workhouse Campus site is listed on the National Register of Historic Places. Completion is anticipated for November 2022.

F. J Busse Company is the general contractor for the Liberty Center Eighth Floor Spec Space, a fit-out of 5,000 square feet of office space. The architect is Desmone Architects.

DiMarco Construction was awarded the general construction contract for the $16 million new municipal complex for South Fayette Township. The 36,400 square foot multi-purpose facility was designed by Kimmel Bogrette Architecture + Site.

DiMarco Construction has started construction on the 12,000 square foot new BC3@Armstrong facility for Butler County Community College in Ford City, PA.

FACES & NEW PLACES

Aaron Mitsch joined **Independence Excavating, Inc.** as a project engineer. Aaron is a graduate of the University of Pittsburgh with a Bachelor of Science in Civil Engineering. Prior to graduation, he completed a full co-op cycle with Independence.

Anthony Gansor joined **Independence Excavating, Inc.** as a project engineer. Anthony is a graduate of the University of Pittsburgh with a Bachelor of Science in Civil Engineering. Prior to graduation, he completed a full co-op cycle with Independence.

Angela Hafen joined **Volpatt Construction Corporation** as administrative assistant.

Landau Building Company announced **Jamison Vernallis** has joined the team as marketing coordinator. Jamison will be joining the Master Builders' Association of Western Pennsylvania Marketing Committee as a representative of Landau. She is a graduate of Hobart and William Smith Colleges.

Landau Building Company announced **John Solomon** has joined the company as project engineer. John joins the Landau team from Behrens & Associates, an environmental noise control company. John oversaw their Northeast Territory as an Acoustical Sound Meter Technician. John is a graduate of Indiana University of Pennsylvania.

Massaro Corporation announced that it had hired **Danny Contreras** as project engineer.

Massaro Corporation announced that it had hired **Ireland Mauler** as project engineer.

Massaro Corporation announced that it had hired **Mitchell Radigan** as project engineer.

Massaro Corporation announced that it had hired **David Zbel** as project engineer.

Massaro Corporation announced that it had hired **Olivia Mendizablal** as graphic designer.

Rycon announced the opening of its eighth office in Houston, Texas. **Mike Diehl** has joined the company as president. A seasoned industry professional, Mike has more than 30 years' experience with degrees from University of Florida and Oklahoma State University.

Rycon's Fort Lauderdale office welcomes **Colin Apruzzese** as junior estimator, alumnus of University of Central Florida with a degree in industrial engineering.

Daniel Anderson joins **Rycon's** Building Group as project assistant, an alumnus of the A. Phillip Randolph Institute.

Rycon welcomes **Marc Anthony** as junior network administrator. He received his computer science degree from Slippery Rock University.

Ian Durham joins **Rycon's** Casework & Millwork Division as project manager with 10 years' experience.

Rycon's Cleveland office welcomes **Paul Hageman** as project manager who received his Civil Engineering degree from Youngstown State University.

Colin Keller, CSP joined **Rycon** as safety coordinator.

Marcus Keller, alumnus of West Virginia University, joins **Rycon's** Washington D.C. office as preconstruction manager.

Rycon welcomes **Elizabeth King** as executive administration assistant, an alumnus of Point Park University.

Rycon's Building Group welcomes **Brandon Lee** as assistant project manager.

Haley Loesch, alumnus of Kent State University, joins **Rycon** as proposal coordinator.

Rycon welcomes **Reese Sansom** to the Atlanta office as estimating coordinator.

Ayana Smith joins **Rycon's** Fort Lauderdale office as estimator.

Rycon's Philadelphia office welcomes **Bonnie Stead** as project accountant with 26 years' experience in the industry.

Jason Stump joins **Rycon's** Cleveland office as estimator. He has his civil engineering degree from Cleveland State University.

Rycon's Washington D.C. office welcomes **Dee Yates**, with 20 years' experience, as senior project manager.

Rycon's Ronak Mody, assistant project manager, received LEED Green Associate Certification.

Rachel Dancer joined **Turner Construction** as field engineer. She is a recent college graduate from the University of Pittsburgh with a degree in civil engineering.

Quinn Aker is a **Turner Construction** co-op from the University of Pittsburgh who is studying for his civil engineering degree.

Rhea Khot is a **Turner Construction** co-op from the University of Pittsburgh who is studying for her civil engineering degree.

Nello DeSantes transferred to **Turner Construction's** Pittsburgh office from Philadelphia. DeSantes is an 11-year industry veteran and serves as a project safety manager.

Thomas Clancy joined **PJ Dick's** Mid-Atlantic office as project manager. Clancy earned a B.S. in Construction Engineering from Temple University and an MBA from University of

the Sciences. He is serving as a project manager at the Montgomery County Courthouse Phase I Demolition project and will transition to the Cedarbrook Senior Care and Rehab Addition project.

Mario Camerota joins **PJ Dick** as a project manager on two PJD-Industrial projects: Eight Points Wind Farm and ALCOSAN East Headworks. Previously, Mario spent almost 12 years at Walbridge working with the self-perform concrete, steel, and equipment installation groups. He is a graduate of Westminster College with a B.S. in Business Administration.

Jim Saxon joined **Mascaro** as a project manager. With over 25 years of experience, Jim has overseen various projects including renovations and new builds. Jim will support the University of Pittsburgh's Campus Recreation Center project.

John Hopper joined **Mascaro** as a project manager. With 20 years of experience John has previously held the roles of project engineer, assistant project manager, and project manager where he managed several multi-million-dollar projects. John will manage PennDOT's Rt.28 project.

Wyatt Kirk joined **Mascaro** as a project engineer at the Carolina Panthers Rock Hill Development in South Carolina. Wyatt earned a bachelor's degree in Civil Engineering, with honors, from Clemson University.

Brandon Diana has been promoted to operations manager for **Facility Support Services (FSS)**. Brandon joined FSS in 2017 as a project manager and received his bachelor's degree in business administration from The Pennsylvania State University.

Beth Cheberenchick, FSS' Business Development Manager, was named President of the Society of American Military Engineers (SAME) Pittsburgh Post. She has served on the board since 2011 in the roles of post secretary and vice president and was also the recipient of the Regional Vice President Award for exemplary service.

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CLOSING OUT

OUR JOURNEY INTO THE WORLD OF CONSTRUCTION TECHNOLOGY: WHY WE DID IT

BY RAYMOND VOLPATT JR.

Like many other contractors, at the onset of the pandemic in early 2020 my team and I were faced with the cancellation or postponement of a significant amount of backlog. As "non-essential" projects were put on hold, the effect on short term revenue and potential loss of key staff members was becoming a reality.

Foreseeing the looming shutdowns, my accountant and I met and reviewed our financial position. Together we figured out that if we had no project-related revenue or expenses I could keep my in-house staff on for two and a half years before running out of reserves. I was relieved to know that I had time on my hands, but with the uncertainty of the pandemic, the clock started ticking.

I took this time to focus my efforts on the future of Volpatt Construction. With the help of my brother Michael, a Silicon Valley technology consultant and advisor, we began exploring how we could use technology to transform our business and the industry at large.

Every commercial construction executive is aware of the challenges we face when it comes to managing margins. Rising material and labor costs counteract the desire owners have for cost reduction. I knew it was time to take a closer look at how we could manage projects more efficiently.

At the time, my brother was advising a company called UrsaLeo who developed an innovative digital twin platform now known as Gemini. Working closely with the founders, Michael recommended bringing Volpatt in as an advisor to identify ways that the technology could be used in the construction industry.

As we dug deeper into the platform's potential, it became clear that with access to the drawing files we could create a digital twin of a project and use it during construction as a management tool. The physical space itself could be fitted with sensors that send data back to the twin, giving users the power to view project ongoing operations from any internet connected device. The ability to set parameters for each sensor and send alerts to project superintendents or directly to people in the office when thresholds have been met was also attractive.

Imagine receiving an alert that equipment is overheating on the job or negative air pressure requirements are being exceeded. Remote control features could give us the power to monitor equipment on site, change temperature and humidity settings, and more. Responding and reacting to issues in real time, before a problem arises, would be a game changer for us and any contractor looking to work more efficiently.

Collaboration tools would also allow us to work remotely with the owner, the design team and the field to resolve issues from afar, limiting the need for on-site ad-hoc meetings thus mitigating job progress delays.

The more we explored, the more we realized how powerful this would be for our business and for others. Our team is actively piloting the technology and fine tuning the features so that future projects will all have a twin as part of overall project management.

The two teams, UrsaLeo and Volpatt Construction, also recognized the value that the twin could have after project completion. Armed with a twin, owners could integrate it into an existing building management system to help monitor and control the space in real time. We quickly recognized the value this would bring to an owner's post-construction needs and saw the opportunity to redefine how we operate as a company.

Realizing that we had an opportunity to harness this technology beyond construction prompted Michael and I to start a new business, called ShareInTech. ShareInTech would be solely focused on reselling UrsaLeo technology to our peers in the construction industry.

Our new business is now exclusively marketing this technology in Pennsylvania, Ohio, West Virginia, and Maryland. And we are collectively marketing the technology with UrsaLeo to identify additional customer opportunities.

Beyond construction, the digital twin technology offers a tool to help the public and private sectors reverse the effects of climate change through decarbonization. Building owners and operators can use the technology to monitor and control energy usage in facilities, allowing them to reduce carbon emissions as they work towards net-zero and decarbonization goals.

Along with our partners at UrsaLeo, we see this as a huge opportunity. UrsaLeo is currently working with the Active Building Center in the UK on a pilot project that will allow the government to monitor and control energy consumption at public housing projects. Our team anxiously awaits case study data from the pilot so we can share it with potential customers on this end of the pond. I believe the technology can help move our construction clients, along with all property owners, towards more aggressive decarbonization strategies here in Pittsburgh and elsewhere.

While the last two years were tough for many, I am proud that the circumstances forced us to look inward. Construction is my family's business but reflecting on our business to redefine how we work and what we could do to enact change was one of the best moves we've ever made. My brother and I both feel like we were forced into a real-life MBA program. Only the future can tell if we've passed with flying colors.

Ray Volpatt is president of Volpatt Construction and president of the Master Builders' Association of Western PA Board of Directors. He can be reached at rayjr@volpatt.com.

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