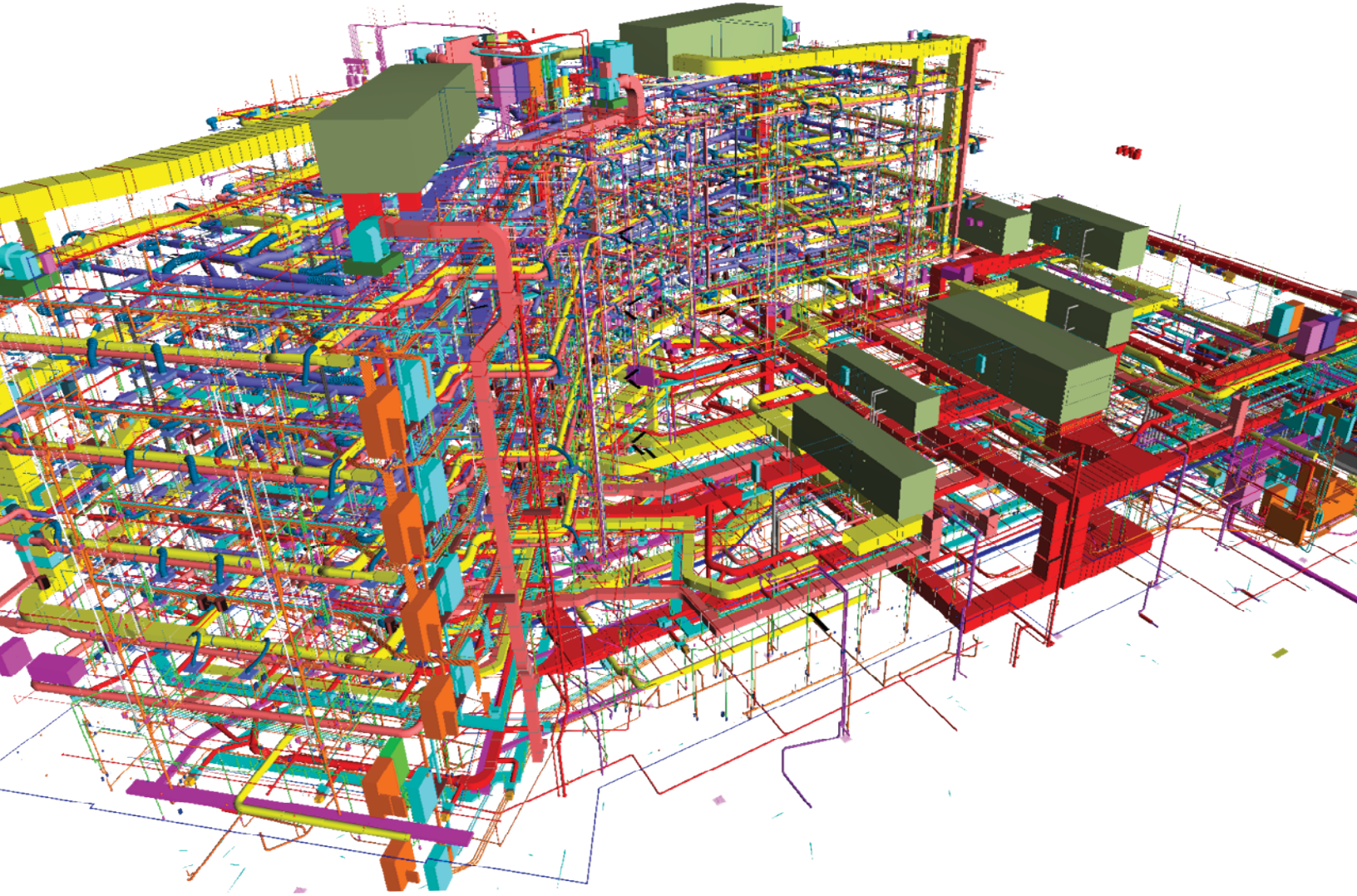


Construction Productivity

AN ENGINEERING SOCIETY OF DETROIT INSTITUTE **SYMPOSIUM REPORT**



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BRIDGES OF
INNOVATION

A SYMPOSIUM REPORT

Construction Productivity

Identifying the Opportunities for Advancing the Competitiveness, Efficiency and Productivity of the Michigan Construction Industry

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This report is published in memory of the man who made it possible:

David A. Skiven PE, FESD

1947-2011

Co-Founder of The Engineering Society of Detroit Institute
Retired Executive Director, Worldwide Facilities, General Motors Corp.
ESD Vice President, 2004-2008
ESD Board Member, 1998-2008
Horace H. Rackham Humanitarian Award Recipient
ESD Fellow
Harold Slaight Ellington ESD Leadership Award Recipient
Rackham Engineering Foundation Trustee





DAVID A. SKIVEN LEADERSHIP FUND

FOR THE BENEFIT OF
The Engineering Society of Detroit Institute

With the blessing of his loving family, ESD has created the David A. Skiven Leadership Fund for the benefit of the Engineering Society of Detroit Institute to continue the work Mr. Skiven was so passionate about. If you are interested in contributing to this fund, please visit www.esdinstitute.net or contact Lori Birman at 248-353-0735, ext. 120, or lbirman@esd.org. You may also mail donations, payable to ESD with "Skiven Fund" in the memo field, to:

**The Engineering Society of Detroit
David A. Skiven Leadership Fund
20700 Civic Center, Suite 450
Southfield, MI 48076**

Dave put people first. He had in his travels seen all kinds of folks. He saw leaders in name only and he saw greatness in those unrecognized. What drove him was simple: help others with ideas that can be implemented.

—CHRISTOPHER J. WEBB, JD, FESD, Co-Director,
The Engineering Society of Detroit Institute

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*Available online at www.esdinstitute.net.



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Acknowledgements

They are building the second bridge, and they're doing it in China. The segments will be shipped 6,500 miles from Shanghai before being assembled on site. The second bridge is a sign of how China has moved on from building roads and ports in Africa and the developing world and is now aggressively bidding for, and winning, major construction and engineering projects in the United States and Europe. China has built state-of-the-art skyscrapers in Beijing and Shanghai—some in the blink of an eye—and architecturally stunning buildings like the Bird's Nest stadium and the Guangzhou Opera House. It has engineered and constructed a high-speed rail network that is coveted worldwide, and now Chinese construction companies are full of capital and confidence. According to *Engineering News Record*, five of the world's top 10 contractors, in terms of revenue, are now Chinese, and China State Construction Engineering Group (CSCEC) has now overtaken established American icons like Bechtel. In fact, CSCEC to date has built seven schools in the United States, blocks of apartments in DC and New York and is in the middle of building a 4,000-room casino in Atlantic City. In New York, it has won contracts to renovate the subway system, build a new metro platform near Yankee stadium, and refurbish the Alexander Hamilton Bridge over the Harlem River.¹

And now they are building the second bridge. In San Francisco.

Does this disturb you? Michigan is in the market for a new bridge, but this bridge is being funded by Canada. Based on the amount of money California is said to have saved by importing from China—\$400 million—off-shoring could be an attractive option for Canada. The State is saving hundreds of millions of dollars by opting to have its bridge built by a country that has figured out a way to do it better, faster and cheaper. Does this sound familiar? This should hit very close to home for Michiganders who remember the mass auto company layoffs in the 1970s and 1980s when Japan found better, faster and cheaper ways to produce cars—and export them here.

Why not here? Why can't Michigan be China? Michigan's advanced manufacturing base includes more than 381,000 workers at 11,000 companies,² indicating that it could be very well suited for the exact type of modular build that China is capitalizing upon

for the San Francisco bridge. And with a strong base in construction engineering and trades, coupled with a high capacity to train, Michigan's workforce is ideal for implementation of major field projects. If there is to be a second span, what better stage upon which to showcase the powerful results of Michigan industrial cooperation than a new gateway to international trade?

It is one thing, however, to point at the existing elements, and quite another to present a finished product. Certainly Michigan has strong industrial infrastructure, a well-trained population hungry for work, intermodal transportation capabilities, etc.; but so does Virginia. Connecticut. Nova Scotia. Shanghai. Michigan needs to distinguish itself with an innovative thread to bundle this wealth of resources into a cohesive, world-class operation. In other words, Michigan needs an integrative prospectus that makes it foolish to NOT do business here, headquarter here, export from here. What better industry to build the new model than construction?

Michigan now finds itself with the enormous opportunity to apply its history, capitalize on new technology and implement fresh perspectives on business relationships and it is on the precipice of the perfect vehicle in construction; we know it can be done, because China is doing it! But we are positioned to do it better. Never before have business and labor worked so closely together. Our report is a testimony to this aligning of arrows to make Michigan the place of choice. The short window of opportunity in which Michigan currently finds itself has overwhelming potential to reface construction and manufacturing in tandem, all while upholding the Snyder Administration's goal of making Michigan an export state. The window is just that, however: short. This group of divergent stakeholders convened with the pointed goal of new, innovative ways to increase efficiency in the Michigan construction industry, and recognized—nearly unanimously—that something needs to change immediately for the industry to remain viable; this aspect was unique and has never been present in one of our symposiums before. The highly regarded panel of speakers³ presented a profusion of information that showed not only from whence we came, but where we are sure to go if we continue down the same path. The most impressive feature, however, was the consensus on recommendations coming from the workgroups. The industry leaders have spoken: the time is ripe for successful, innovative change, and if we don't act now, someone else will.

1. For more information, visit <http://abcnews.go.com/WNT/video/us-bridges-roads-built-chinese-firms-14594513>

2. Caroline M. Sallee, et al. *The University Research Corridor's Support for Advanced Manufacturing in Michigan*, Anderson Economic Group (July 2010).

3. A complete account of this symposium's speaker panel may be found in Appendices G-P, available at www.esdinstitute.net.

Executive Summary

Our Mega Question for this symposium was “How can Michigan create consensus for a model comprehensive construction implementation standard that will serve the needs of the 21st century?” Once again, the question imbeds the importance of consensus and our future.

Workgroups for this symposium answered this question with breakthrough ideas relating to construction best practices. These practices were based upon proven and cutting-edge methods like BIM, lean principles, integrated project design, workforce training and development, prefabrication, modularization, and commercial and legal innovations. We summed up the practices with the term Integrated Delivery. At the conclusion of the symposium, the attendees unanimously embraced the use of Integrated Delivery. There was little, if any, disagreement among our diverse stakeholders representing some of the very best of the owner, contractor, A/E, and labor communities about what was needed to advance the industry. That’s the good news.

Now for the other side of the coin. How could these great ideas be achieved? Some data highlights from symposium presentations may be useful to set the stage for our recommendations:

- The U.S. share of global construction in 1988 was 25 percent. In 2009, it was 15 percent. What will be our percentage in 2012 or beyond? The numbers are not currently available by accountants, but our construction practitioners sense the downward curve.
- The U.S. is still the most productive construction environment in the world, but our productivity growth rate is declining.
- For a representative project, BIM/Lean-Enabled Design results in a 40-week build out. Design/Build-Build Fast Tracked is 50 weeks. Design/Bid/Build Fast Tracked runs 60 weeks.
- Waste in manufacturing here is 26 percent of the pie with value-added content at 62 percent. Waste in construction is 57 percent with value added content at only 10 percent.

Is construction lagging because our domestic market for years was insulated from global competition? While it is maddening to consider that the supply of a second bridge to San Francisco will come from China, shouldn’t we be thankful for this external force? Shouldn’t we take to heart that the kind of global competitive forces that changed our manufacturing might do the same for construction?

One informative presentation at the symposium, entitled “Enlightened Project Delivery,” gave us hope.

It’s subtitle, “How to Make Sure That You Design What’s Wanted and Build What’s Designed, on Time and Budget” tells it all. When the arrows of owner, prime, and subcontractors, A/E firms and labor are aligned, risk and waste are driven out and consensus decision-making brings the project to a successful conclusion. To foster trust building, the owner in this case study took the jump to a new contract model: a single contract signed by all the project stakeholders. That was key. If one failed, all risked failing with a safety net of a cost reimbursement formula after profits were lost. It’s a step beyond the open-book approach and not dictated by an owner’s need of control for control’s sake alone.

With this in mind, symposium attendees at the beginning were energized and focused on a model construction contract including collective risk management, labor/management operating agreement, shared risk and reward, metrics for construction productivity, and last but not least owner leadership. Like those who love construction, the goal was simple. Let’s roll up our sleeves, apply Integrated Delivery, and get the job done on time and within budget.

In the panel discussion midway in the symposium, members offered some healthy reality checks. First, a fundamental problem was lack of trust and today’s contract documents take the trust out of everything. The second monster they shared was the fear. Fear rarely fosters collaboration. Without collaboration, the chances of enjoying the benefits of “win-win” thinking and acting are slim. Or to put it another way, the fruits of conflict are often inefficiency and waste. And finally the panel identified the beast of lack of commitment or avoidance of accountability. All hail to the god of waste!

Near the end of the symposium, the strategy workgroup reported out a consortium body that would take a leadership role giving Michigan’s construction industry one voice focusing on marketing the positives of Integrated Delivery. This workgroup examined past efforts like the Great Lakes Construction Alliance, Michigan Construction Industry Partnership, and the Michigan Owners Contractors Association and concluded that while well-intentioned, these efforts lacked sustainability due to, among other things, reduction in owner commitment, inability to reach consensus, lack of authority, and no dedicated staff or resources. Perhaps best said, its members were in the business, but not of the business of managing a major start up or organizational entity to drive change. Figure 46 of this report captures well the outcomes from the strategy workgroup.

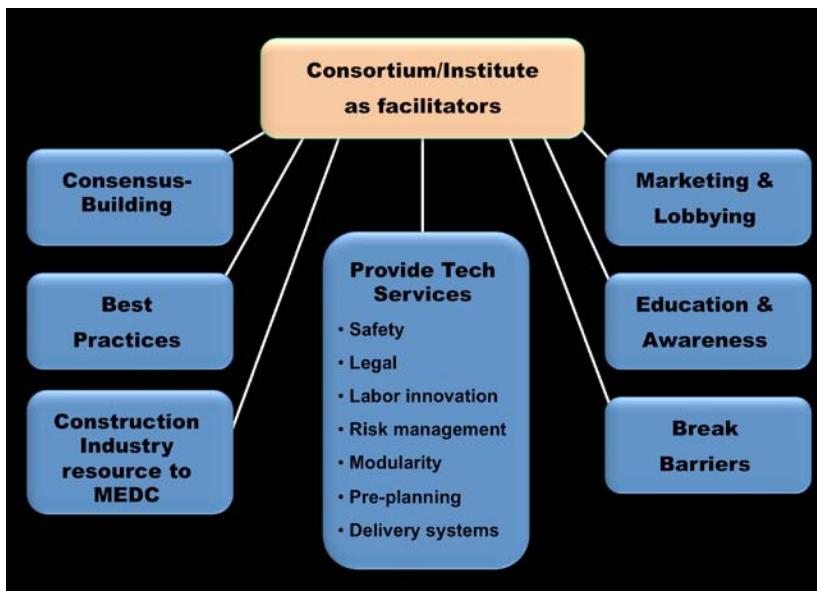


Figure 46 (duplicated from page 55): Strategy Workgroup Consortium Model

All of our attendees concluded that this model could be the catalyst for critical transformation and implementation of today's well-recognized and tomorrow's newly generated best practices to distinguish Michigan as our nation's construction thought and action leader. The workgroup's work product is a great roadmap that the Institute wholeheartedly endorses. It takes past efforts to the next level, especially in terms of the need for a viable business plan, organizational governance structure, and sustainable funding and staffing.

But does it go far enough? Can a report's conclusion of a new entity alone make the slogan "Made in Michigan" a reality for the creation of wealth and jobs? Would a new entity assuage our current worries—real or perceived—of the decline of Michigan and the U.S. as a construction powerhouse? Will this model, as the culture workgroup noted, transform the current construction culture? Indeed, the culture workgroup's work product should be incorporated into the strategic workgroup's model. Great so far, but again will it make the difference?

The technology workgroup had it relatively easy. Many of the best construction practices are generally known. Some, however, are closely held and protected by companies hoping to maintain a competitive advantage. When combined with the work of the legal workgroup, Integrated Delivery begins to take shape driving out commercial risk, optimizing collaboration, and adding value instead of waste.

In the view of the Institute, the present economic and political climate is a disincentive for the broad voluntary application of best practices in

the construction industry in part due to the fragmentation of the owner stakeholder base being both public and private. Owners purchasing "silos" dominate the landscape, resist innovation, and hold fast to what has been done in the past. The risk of advancing or of experimenting with different practices beyond the lowest bidder approach outweighs the chance of future benefits.

For example, one university buys and builds its way and another in a different way. There is no consistency of construction buying practices and frankly it's no secret that hard times make for a buyer's market. So, "Why change?" is the conventional

thinking. And a low bidder is too often the winner at the award stage only to become the loser at the end of the project after the cost overruns, change order battles, bonding disputes, threats of default, or, worse, the litigation. Survival of the fittest. Darwin would be proud.

So, how do we change the rules of engagement for the better and do so on a sustainable basis? The recommendations of the Institute set forth below are geared to answering this fundamental question.

RECOMMENDATION 1:

The Governor of the State of Michigan should appoint a blue-ribbon voluntary task force made up of key public and private stakeholders from the owner, contractor, architect/engineering, and labor communities, as well as management, insurance, bonding, and financial professionals to assess the findings of this report and other pertinent information. Within six months from its formation, the task force would be asked to submit its white paper recommendations for implementation of best construction practices for any construction project funded by public funds in whole or in part.

To jumpstart the work of this symposium and move this report from the shelf to reality, we see

the best fast-track opportunity through action by the governor's office. The governor holds the purse strings for the funding of publicly funded infrastructure, medical, and higher education construction projects and has an oversight responsibility to make certain the funds are wisely spent. This recommendation would not require legislative action and could be implemented by executive order across the board.

As an "owner," the State of Michigan has substantial buying power. If transformed by the application of best practices, this power could relieve budgetary pressures and offer immediate savings for taxpayers and for those served by state government. For the same dollars or less, more could be accomplished. For example, university construction costs are a significant driver of educational costs in total. Construction savings will translate into reduction of the costs of education. For parents planning for their children's education, lean construction would suddenly take on a whole new meaning. All of this translates into lower operating costs for the state and benefits for all Michigan citizens. Streamlining and harmonizing current buying and construction regulations through uniform best practices would also be a worthy byproduct. Over 180 current approvals may apply to construction on a university campus in Michigan. Enough said.

Do we want a bronze plaque that says "Made in China" or "Made in Canada" on our future construction works in Michigan? The Institute is "global blind" respecting and recognizing all construction leaders, but advises us not to rest on our laurels in the daunting face of world competition. Now is the time to be proactive and realize the benefits of this recommendation.

RECOMMENDATION 2:

Building on the results of past ESD Institute symposia, legislation should be enacted to create an authority under Michigan law that would mandate the use of best construction practices within the jurisdictional scope and purpose of the authority.

The ESD Institute Symposium report "Building Consensus for Michigan's Integrated Global Freight Hub," published March 9–10, 2011, offered a fortuitous opportunity for the application of this recommendation. All stakeholders either

for or against a second bridge across the Detroit River agree that unless built without public funds, an authority of some sort is needed for its construction, operation, and maintenance. This authority would offer a vehicle for the implementation of best construction practices if a second bridge is constructed.

On a larger scale, the Institute's symposium report "The Michigan Green Enterprise Zone Initiative," published March 19–20, 2009, as further refined in our subsequent symposia provides a Michigan-wide investment authority that would optimize the benefits of the cutting-edge application of best practices for construction undertaken by the Zone.⁴ This, together with the application of other best practices relating to labor, legal, medical, and other innovations, is the unifier and enabler for economic turnaround and for the realization of Michigan as an export state of choice. Enabling legislation for this purpose is available on our website.⁵

RECOMMENDATION 3:

The Engineering Society of Detroit and its Institute welcomes the opportunity to serve in a facilitative and supportive role in order to make the above recommendations a reality.

Given the board reach of ESD to over 60,000 professionals including corporations, architectural, technical and construction entities, educational institutions, building owners and managers, and unions, we believe that our role as an independent, neutral, and nonpartisan entity should be used by all stakeholders as referenced by the work product generated from our symposium workgroups. ESD would host a steering group over the near term to achieve these ends. Subject to ESD board approval, members of a task force would be identified for this purpose.

In conclusion, we accept the challenge offered by David A. Skiven, co-founder of the ESD Institute, "Why not search for those solutions that are just in front of us? They are ours to find and implement for this generation and next."

4. An excellent summary of ESD Institute work is available in our 2011 Portfolio on our website at www.esdinstitute.net.

5. See www.esdinstitute.net/greenzone for the draft legislation for the Michigan Investment Corporation Act.

About The Engineering Society of Detroit

The Engineering Society of Detroit (ESD) was founded in 1895. Its membership consists of over 6,500 individuals and 3,000 corporate members. With its 87 affiliated technical societies, 34 construction organizations, 38 educational institutions, and 52 unions, ESD's reach extends to over 60,000 technical and scientific professionals. ESD's Board of Directors includes a diversity of leaders in business, government, manufacturing, engineering and design, academia, and health care.⁶

ESD collaborates with nearly 100 nonprofit organizations including Automation Alley, Detroit Regional Chamber, Detroit Renaissance, Michigan Chamber of Commerce, Michigan Economic Development Corporation, NextEnergy, Oakland County, Oakland County Michigan Works!, Society of Automotive Engineers, City of Southfield, and Wayne County. ESD provides professional training, certification and accreditation programs in conjunction with the majority of Michigan's universities and community colleges.⁷

About The ESD Institute

The ESD Institute was formed through unanimous approval of the Board of Directors of the Engineering Society of Detroit through a mega question facilitation in December 2008 and benefits from seed funding from the Rackham Engineering Foundation. The ESD Board of Directors established the charter of the Institute as follows:

- **ESD Institute Vision:** Finding a sustainable tomorrow with integrity that serves our members and society.
- **ESD Institute Mission:** Fostering greater unity, focus, and choice for the implementation of innovation, maintenance, and attraction of investment capital and the betterment of society.

The charge of the Institute is to advance through excellence and collaboration the successful implementation of innovation by bridging creative and independent thought with concrete and meaningful action.⁸



6. A complete listing of the Board of Directors of The Engineering Society of Detroit is in Appendix E.

7. Further information regarding The Engineering Society of Detroit is available at www.esd.org.

8. The Co-Directors of the ESD Institute are David A. Skiven, PE, and Christopher J. Webb, JD. The Deputy Director of the ESD Institute is Kristin Van Raaphorst. For further information, please visit www.esdinstitute.net.

About the Process and Outcomes

As a matter of process, the ESD Institute identifies topics for consideration called Initiatives. Individuals are invited to serve as volunteers to examine an initiative in the context of a workgroup referred to as a symposium. Usually attendees represent a diverse range of expertise and perspectives. Attendance at a specific symposium is limited by invitation. Attendees serve as individuals and not as representatives of organizations or interest groups. Each is selected based upon his/her good judgment, experience, and expertise and is asked to disclose any potential of bias or conflict of interest that might prejudice the work of the Institute.

A symposium usually occurs over a two-day period and may be continued for further deliberation if warranted by the Institute. An internal Institute committee, made up of the directors and assigned staff of the Institute, a select group of ESD Board members, and on occasion representatives from outside organizations, frames the issues through a summary of the initiative, facilitates the work of the symposium, and acts as a reporter for the symposium. The Institute's goal is to provide a meaningful and effective contribution geared toward the application of new ideas that can be considered and implemented by policymakers.

While attendees should strive for agreement in a report, consensus is neither required nor desirable if achieved at the cost of weakening the analysis or conclusions reached during the symposium. Accordingly, it may at times be more valuable to explain the rationale behind areas of disagreement than to issue unanimous conclusions that are so limited they fail to contribute to a better understanding of the issues presented by an initiative.

It is important to note that the role of The ESD Institute is to maintain the independence, objectivity, and integrity of the process and not to advance a specific outcome or result. Any report is collective work product of those attending the symposium.



“The Institute’s overall focus is to find socio-economic unifiers and enablers to propel Michigan’s economic and employment turnaround.”

Opening Presentations & Plenary Session⁴

Welcome

Michael Cooper, PE, LEED AP, FESD
 Managing Principal, Harley Ellis Devereaux
 Vice President, The Engineering Society of Detroit

HIGHLIGHTS:

- The Michigan construction industry is hurt by its external perception
- The inherent lack of trust in the industry can be overcome

Good morning, everyone, and welcome to The Engineering Society of Detroit Institute's Symposium on Construction Productivity. Thank you very much for taking time out of your day to be with us. I'm confident that when we look back, we'll all be glad we did.

The construction industry is facing some serious systemic challenges right now. A struggling economy coupled with the resulting decline in construction spending (i.e., lack of work) has really fueled an ultracompetitive environment. We're at a point where bid prices are actually approaching or even falling below the real costs of labor and materials. Common sense tells us this is not sustainable and is hurting an industry that could represent as much as 8 to 10 percent of our gross domestic product. We're battling perceptions that our industry is a dinosaur, and I'm sure you've heard before that we are slow to adopt new processes and technology and content to do things the way we did decades ago.

Our workforce lacks the skills to be competitive in today's marketplace and there's an inherent lack of trust in the industry that prevents true partnering and maximum efficiency. We're also battling ongoing debates at the federal level on deficit control, taxes, and healthcare, which are impeding investment and growth in our industry. The question for today is what can we do to change the landscape?

First off, let's recognize that perception does not have to be reality. From the perspective of



engineering, technology, manufacturing, and skilled labor, Michigan has the capability and infrastructure to compete with anyone, anywhere. We have the opportunity to continue employing technologies such as BIM and 3D lasers to increase the speed of services and the quality of work, to continue to leverage the technical experience of our workforce to boost productivity, to continue to use a lean manufacturing background to fuel construction efficiency, and to continue a progressive approach to partnering to build a more sustainable commercial environment.

Our charge today is to embrace the wide range of perspectives here with us, to sit together and discuss the tough questions, put aside individual priorities and biases so we can address core issues, develop new approaches to move industry forward, and demonstrate a willingness to implement new ideas so we can reap the benefits of our efforts.

Time is of the essence because of the significance of our industry. I've read that nonresidential construction spending in the U.S. last year totaled more than \$550 billion, with more than \$6 billion of that right here in Michigan. Construction employment is more than 5 million nationwide and 125,000 right here at home. Construction has been one of our core industries and will continue to be for the foreseeable future.

9. In some cases, the following represents only highlights and leads of the opening presentations. These can be found in their entirety as appendices online only, at www.esdinstitute.net.

Introduction

Kristin Van Raaphorst, MPA/CED
Deputy Director, ESD Institute

HIGHLIGHTS:

- This process can change the landscape with an open mind
- Integrity will move us forward

Good morning and welcome! My name is Kristin Van Raaphorst and I am the Deputy Director for the Institute here at The Engineering Society of Detroit. I have been here a little shy of five months and I'd like to tell you a little bit about why I'm here.

My background is in public policy, which can mean a lot of things. It's as general as an attempt to address a public issue, and it's as specific as working to pass legislation for better playgrounds in a particular neighborhood. What's ironically universal in the realm of public policy is the fractured nature of how issues get dealt with, which is frustrating and disheartening, and what led me with hope in my heart to the ESD Institute. Chris Webb and Dave Skiven, along with Darlene and the ESD Board, have implemented a process that brings all of the stakeholders on any given issue into a room and welcomes all opinions, no matter how divergent, to be expressed and considered.

The Institute is committed to maintaining independence, objectivity, and integrity. We are not looking to advance any specific outcome or result. The object is consensus, but it is NOT a requirement and can't come at the cost of weakened conclusions. At times it may actually be more valuable to explain the foundation of differences than to present agreement limited in scope.

We talk a lot here about the incredible experience of our youth symposium, about how we brought together 110 kids into this space and heard them say, out loud and without fear, what they want their city to look like when they're 30. I'm here—and I want to let you know that I came to the ESD Institute through a long and grueling interview process—because I believe that it's not too late for people who ARE 30 to make Detroit—and Michigan—what they want it to be. I believe it is not too late for people who are well OVER 30 to make Michigan what they want it to be.

What kills a population's effort to reinvent itself, though, is when one hand can't talk to the other, when there is a lack of cooperation—a lack

of communication—between the parties affected; because without it, it's impossible to look past specific needs and recognize there are solutions out there that are beneficial in a number of degrees to everyone involved. Prescriptive solutions are rarely effective when they merely rebrand the “haves” and “have nots.”

That's the beauty of the Institute process and why it is fresh perspective on macro public policy. So I encourage you to consider carefully the presentations you are about to hear, both for what they are and in the light of your own experiences. And maybe the combination—or the departure from what you know—inspires something different in your head than anything you've ever seen. When you break into workgroups, I hope you share that thought, whether it be a slight tweak on something standard or something you initially react to as crazy. And I also encourage you to be open to the “crazy” ideas of others. There's a quote at the back of the portfolio in your folder that reads, “What use could the company make of an electric toy?” That was Western Union, turning down the rights to the telephone in 1878. And I draw attention to it because most of what we consider commonplace today started as an outside-of-the-box thought that needed to gain momentum before it ended up evolving our entire society.

That's what we need today, frankly, because nothing is going to change if we keep doing things the same way. There comes a point in every industry, in every society since the beginning of civilization, where it is “innovate or die,” but if you acknowledge the horizon you have the great opportunity to get ahead of the wave and define the rules of change. And that is why you're all here, I think, because you know it's true.

With that, I cede the floor to Chris Webb, Co-Director of the ESD Institute. I thank you for your time and look forward to being a part of this process with you.

*There comes a point
in every industry, in
every society since
the beginning of
civilization, where it is
“innovate or die,”*

Introduction *continued*

Christopher J. Webb, JD, FESD
Co-Director, ESD Institute

HIGHLIGHTS:

- Made in Michigan is more than a marketing slogan
- There is a window here, but the situation is increasingly urgent

brought the monkey up. I've been doing this a little too long, but I was trying to figure out what to say to you all this morning to get you inspired. Some of you have been here before and you go, "Look, are we going to talk about the same thing we talked about two or three years ago, and nothing's gotten done, so, Chris, how come you don't have it done yet?"

So the bottom line is that now I'm going to give it to all of you. Our job—as my boss used to say, "I give ulcers, I don't get them"—is to give you an ulcer, give you an opportunity to do something that's really great.

Right now I think of Winston Churchill, and here's where I'll tie in the monkey: never talk to a monkey when there's an organ grinder in the room. And the other one that he came up with is, do you want to be a critic or do you want to be an actor? Right now businesses are making decisions and unions are making decisions, and all of us are making decisions about whether we should write this place off. The investment will go to another country, will go to another place, and it won't be coming here. Is that what we want?

Now, let's look at the supply lines for a minute. Do we need to think about Tokyo power? I'd like to have the iPhone made here. Let's talk about that for just a minute. The iPhone is, what, made in Singapore? Made in China? Made in South Korea? Foxconn Technology Group has the highest suicide rate, and now they're going to introduce robots because Chinese labor is too expensive. Do I need to go on and on? So what are we going to do?

And I challenge this group. You've got an opportunity: talks with the UAW have been extended, which might be good news. We've got a window on that. So if we roll up our sleeves and think out of the box over these next few days, you can really send a message. There's a sense of urgency about this.

I'm going to give you a few names and I want you to think about them: George W. Bush. Governor Snyder, Tea Party, Perry, Romney, former Governor Blanchard, Doug Fraser. I bet just that little listing of names stirred something in your guts, OK? In the

*...You have to become
the champions.
Any joint stake from
all the stakeholders in
this room to change the
construction industry and
make Michigan the
place to be on the planet
is going to go a long way.*

ESD Institute Portfolio, which you have a copy of in your packet, there is a quote on the first page: "One of the greatest pains of human nature is the pain of a new idea," and it is. There's a challenge.

Why do people go to war? The gathering storm of Winston Churchill might very well be this. People think they're right and they think they can win. Let's prove them wrong. I remember when I was first starting in collective bargaining. Many of the officers at Jervis B. Webb Company were card-carrying union members, and they were officers of our company because they knew how to get a job done. So we'd watch them when we were trying to do a launch date on a car or copilot a plan for nerve gas disposal or whatever it was, and we'd think "That sucker knows how to bring people together." Two hundred people are working for that individual, and that's a leader, and we thought "We're bringing them up right through the ranks because they're leaders, they're natural leaders."

If we don't come up with at least one implementable idea and use this time, we're all going to be what here? Bus drivers? So if you want to be a bus driver, we need that. But we really are going to challenge you. You've got to do this, you have to become the champions. Any joint stake from all the stakeholders in this room to change the construction industry and make Michigan the place to be on the planet is going to go a long way. We hear a lot of news about people in conflict. You don't hear much news about people in agreement and consensus—let's try to achieve that. It's not about the speakers, but they do set the stage to challenge us.

What Happened to GM Can Happen Everywhere

Dr. Perry Daneshgari

President and CEO, MCA, Inc.

Heather Moore

Associate Implementer and Manager of Research, MCA, Inc.

Dr. Perry Daneshgari is the President and CEO of MCA, Inc. Dr. Daneshgari created MCA, Inc., in 1990 with services focused on implementing process and product development, waste reduction, and productivity improvement of labor, project management, estimation, accounting, and customer care. MCA, Inc., has worked with various national and international companies. Dr. Daneshgari received his bachelor's degrees in both mechanical and civil engineering from Northwestern University, his MBA from Wayne State, and both his MS and PhD in mechanical engineering from the University of Karlsruhe in Germany. He is also the author of The "Chase", "Lean Distribution" and "Agile Construction" for the Electrical Contractor.

Heather Moore is an Associate Implementer and Manager of Research for MCA, Inc., and has contributed to several projects in the Electrical Contracting Foundation, New Horizons Foundation, and the National Association of Wholesale Distributors. She is a PhD candidate in construction management at Michigan State University. She also has an MBA from the University of Michigan Flint, and a BSE in industrial and operations engineering from the University of Michigan, Ann Arbor. She specializes in process design and operations research and has experience working in the construction industry and currently works with contractors and distributors across the country on process improvement.

HIGHLIGHTS:

- The lack of focus on the burgeoning residential market translates to the same results as ignoring the small car market in the 1970s: encroachment and dominance by foreign competitors
- Productivity can only be measured at the system level, which requires segregation of work
- Industry-accepted benchmarks are in development and necessary
- Tasks need to be measured across multiple projects for any meaningful standard development

It's good to be here. Let me start, briefly, because we have such a time crunch to get through a lot of good information you can use and that is being used by more than 400 companies across the United States and Canada, actually across the globe. And, I'd like to thank David Skiven for everything you do for the industry, everything you have done, and you guys have done great work for the industry.

I don't know how you guys asked me to come here, but I guess even small lichen can contribute in moving our country forward. I picked this topic because we have many different industries and that's what we do, is that we see any specific data that are comparable.

Let me take you back in time. It's 1958. Right now GM, Ford, and Chrysler have about 85 percent of the market share. Toyota doesn't even exist in the United States.

Toyota enters the United States market with a car called Toyopet, which has about 55 miles per hour of speed and 27 horsepower. They entered Port of Los Angeles with two cars and the drivers get about 50 miles and the cars overheat, so within about six months they put it back on the ship to Japan. They recognize they have to be ten times more productive than United States in order to compete, because according to the calculations, Germans are three times more productive and Americans are three times more productive than Germans, so they had to be ten times more productive.

They keep working on their productivity, but they also recognize that productivity doesn't come from technology. Productivity comes from process improvement. They have recognized that what Ford did was separate the skilled trade activities from assembly workers. What is you called the segregation of work: to allow the skilled trade to not just build the cars, but actually design the process of production. So they're starting to look at the separation of the technology and process design; in other words, they start focusing on the process innovation, and you'll see the result. And you'll see the same thing happening in construction. About ten years later, they come back to the market with a car that sells for \$2,000 and is now a 60 to 70 horsepower, does about 90 miles an hour, and they're still not a very significant part of the market, except a few things happen in the market. At the time we have a thing called EPA—some of you remember Ralph Nader—that starts the consciousness of the customers about the impact of the vehicle on the environment. So when Toyota comes back to the market, there is no such a thing as a small car market, but they literally created

it because of the oil embargo. Some of you might remember this: people used to shoot each other at gas stations back in the '70s when gas was 25 cents or 50 cents. But they're not sleeping; they enter the market, and each time they're continuously working on the process.

At this time, the norm for changing die in the United States and the world is about two weeks. So because of the die change requirement, every time you have to change the vehicle models, you had to stop the line or you had to dedicate another line for it. So what they worked on, they came up with what they called single-minute exchange of die (SMED). So they went from two weeks to one minute for the change of die. The first time in the history they're able to produce more than ten cars on the same line, so what that does for them is reduces their cost.

SMED then becomes the norm in the '80s, but we still don't see this. You still write it off. It's a small part to the point that Toyota considers their biggest risk in everything else in the United States market because it's one of the most unhomogeneous (sic) markets in the world. The rest of the world is more of a homogenous market; Japan, Germany, Italy, France, they're homogenous markets. The United States is considered to be about seven zones of homogenous, but that makes it an unhomogenous market.

That means they're very scared of it, while we're so not worried about a small car. As a matter of fact, we are so arrogant we give them the first factory in the United States. This factory closes in 1984 because of producing the worst-quality vehicles in General Motors with IBTs higher than 140. They reopen under the same union, with the workers and definitely the same tools. The only thing that changes is the management. They now produce the highest-quality car produced in Northern America.

You say, well, no big deal, it's small cars, who cares, they're not making any money on it. Just five years later, they introduced Lexus, the first luxury car people stood in line for half a year to buy, without any history. As a matter of fact, BMW and Mercedes sued Lexus for dumping because they were \$15,000 cheaper. They didn't find anything.

What happened was that now there was a philosophy with them. When I studied Toyota, they put their best and brightest on the small cars, where GM, Ford, and Chrysler put their best and brightest on Cadillacs and Lincolns. What's the difference? The difference is the small car; they sell 2 million of them. \$1 savings is \$2 million. And besides, after that car part has been tested, they put it in Lexus where the customer is a lot more quality sensitive and price sensitive, and it won't break, versus the other way.

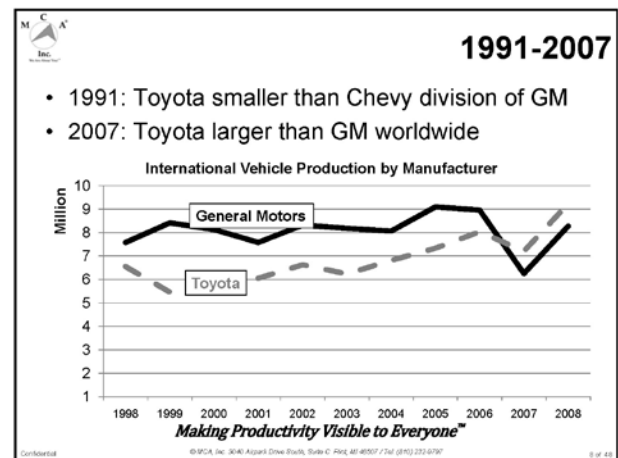


Figure 1

When you look at the history, what happens later, the car manufacturer, which was literally the biggest line in the—on the mountain, as you go forward, you'll see that where GM is—Toyota is still smaller than the Chevy division of General Motors in 1991, and by 2007, Toyota becomes the larger company (Fig. 1). Now, there are a lot of press releases that Toyota had a problem a couple of years ago and so on, but it doesn't hide the fact that the focus was not that much on the technology, but rather, the process innovation, and that's what the construction industry is facing.

Ted [Kennedy] was absolutely right [in a statement during Introduction]; it is not as bad as we think it is. It could get worse, but innovation has to come on process and segregation of work. We are still not segregating work. We are still trying to get the work done by the skilled trade. So one of the other indicators we saw in comparing the two industries is that the United States car market used to be about 25 percent of the world market, and when the technology is no longer the driving factor, the rest of the world picks up, and our car market as a part of the world drops. So when you look at these symptoms, there are a few things that are very common.

For example, markets are shifting, so markets shift from luxury cars to small cars. The small car is very interesting. Small car market size is the same

...innovation has to come on process and segregation of work.

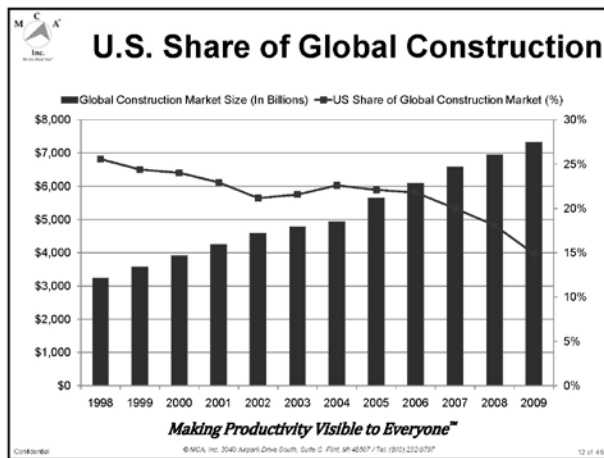


Figure 2

size as residential market size in construction, 38 percent, and we blissfully neglected it. We said we don't want it, it's somebody else's. And that's what you'll see later, that the same thing is happening. Less specialization was required, unionization was declining, types of markets were changing, and the system productivity, not individual productivity, becomes critical. As a matter of fact, all the studies we have done in the last couple of years, it is almost impossible to measure individual productivity. So anybody who tries to measure individual productivity, you have to have the exact same conditions, exact same data, and exact same job to measure productivity at the individual level. The only way productivity can be measured is at the system level, which means segregation of work, how much work is actually being wasted, how much time is being wasted, and changes in productivity.

Let's go to construction now and you'll see the same story.

United States construction used to be about 25 percent of the global market (Fig 2). Because of this and because of reduced productivity—again, a debatable issue—the United States construction market is a very lucrative market, and the less productive you are, the more lucrative it becomes, just like the car markets. Just like the fact that you were focusing on two-week die exchange, somebody came and took that two-week die exchange to one-minute die exchange, then they were able to increase the system productivity by literally tenfold.

When you go farther, what is happening in the industry is that the GDP is changing. GDP over the last three decades has shifted from manufacturing to more service and entertainment. The majority of our export in the United States is no longer manufacturing products. It doesn't mean manufac-

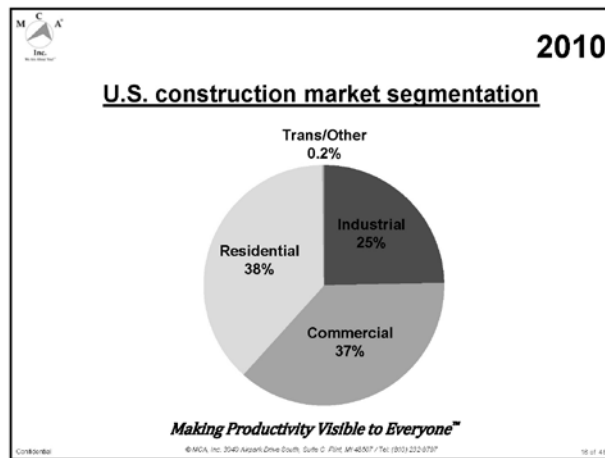


Figure 3

turing has not increased. It just means that the manufacturing is not increasing as fast as the rest of the GDP, which means the type of construction work we do is changing.

We developed a method to measure market size and market share for union and nonunion back in 2005. The construction market shifted from over 50% industrial to less than 50% size of the market because industrial construction dropped below 50 percent back in late 1958 or so, same time as Toyota came here, and then commercial and residential picked up.

As a matter of fact, the projection is more than 75 percent of the construction market in the United States is going to be commercial/residential by 2025 (Fig. 3). That breakdown shows a clearer picture and that, as of 2010, the construction market breakdown at the high level was only 25 percent industrial, 37 percent commercial, and about 38 percent residential. However, but the majority of the research focus in the construction industry of the work we have done in anything we do in construction, which is very small activity, is focusing on the 25 percent industrial.

Let's start with lessons learned from what we are learning here in this industry. Let's make a comparison. Some of you might have seen this. [Video plays] We have a 16-story building being built in China. It will take us approximately 9-12 months to build this. Pay attention to the clock at the bottom. It took the Chinese six days. You may write it up and say, well, yes, there's nothing that is going to stop it from putting this on the back of the ship and building this in San Diego or Europe. Why can't Michigan do that? Why can't we be the Chinese of the United States?

To view the report on this presentation in its entirety, please see Appendix G at www.esdinstitute.net.

Benchmarking and Metrics for Improving Construction Productivity

Carl Haas, PE, PhD

Professor, University of Waterloo, Department of Civil Engineering; Canada Research Chair in Construction & Management of Sustainable Infrastructure; Director of the Centre for Pavement and Transportation Technology (CPATT)

Dr. Carl Haas is the Tier 1 Canada Research Chair in construction and management of sustainable infrastructure and a Professor in the Department of Civil and Environmental Engineering at the University of Waterloo Canada. His research, teaching, and consulting are in the areas of advanced construction and transportation technology, sustainability, and construction productivity. He has served as Chair of the Committee on Applications of Emerging Technologies (A2F09) at the Transportation Research Board. At the University of Texas, he directed the Center for Construction Industry Studies and the Field Systems and Construction Automation Research Laboratory. At Waterloo, he served as Director of the Center for Paving and Transportation Technology from 2005–2010.

HIGHLIGHTS:

- A high productivity rate does not preclude improvement
- There is clear, statistically valid evidence that automation and integration on a project can improve productivity by very large margins
- Planning cuts costs
- Current high productivity measures have flattened, and foreign competition will quickly surpass the United States if things don't improve
- Productivity data from companies is difficult to obtain for many reasons, including proprietary nature and standardization difficulties

Thank you. I'm very honored to be here. I'm just going to say that I'm a little bit more optimistic about construction. I actually think we're at a tipping point in terms of interoperability and productivity and in supply chain management and so on. And personally I spent about three-quarters of my time on the tools and the process development to try and improve productivity, but the thing I wanted to talk about today or I was told that you'd

be interested in is some of the work I'm doing with my colleagues at the Construction Industry Institute (CII) on benchmarking metrics for improving productivity. So it's that demi-measurement and continuous improvement thing that we have to do no matter what, even if we're making really great new tools.

I will start with the background on measuring productivity and then I'm going to drill down from the very top. I'm taking an international kind of macro-economic analysis for construction productivity, then project level analysis, and then an activity-level analysis, to which I credit CII. We did five jobs this summer, so it was an interesting addition. Then I will present final observations.

I've been on about seven CII research teams, and these teams are full of industry experts, as well as academics and their students. These are the folks I work with and learn from, a great group, and there is a lot of expertise brought to bear on problems. This team was focused on improving craft productivity. It's a six-year research program, and we're really only talking about part of what the team is doing. And it turns out, as mentioned before, it's their students who do all the work, gathering the data and doing all the analysis and drafting all the articles and reports. I'm also doing this work with the University of Kentucky and the University of Texas.

How do we measure productivity, performance? I clearly remember being beat up pretty badly by Ted [Kennedy] once in a meeting about how we measure it, and I'm still confused. It's very, very confusing and I'm going to go back one step here. You can talk about factor productivity, which is how much you can output in a particular industry for all the stuff you put into it, or amount of output per dollar input. You can talk about labor productivity, which is labor hours per unit output, labor hours per cubic yard of concrete placed, etc. Direct work rate is wrench time, percent of wrench time, and percent of the time being active. It doesn't need to be productive, but it means you're being active. And then performance factor, which is a little bit like what Perry [Daneshgari] was talking about, which is your expected productivity; you did the job and this is what you're observing over the course of the project.

Those are just some of the challenges involved in measuring productivity, and there are no answers yet, but one thing we looked at in benchmarking and metrics is how effective they are. We also look at how they impact productivity and performance of the project in terms of schedule, cost growth, safety, quality, productivity. We look at the level

Labor Productivity Growth Rate Estimates

Source	Time Frame	Canada	US
Harrison	1961 – 2006	1.09 % (Statistics Canada)	-1.44 % (BEA)
Harrison	1961 - 1981	1.81 %	
Harrison	1981 - 2006	0.53 %	
Harrison	1979 – 2003	0.40 % (Groningen Centre)	-0.84 % (Groningen Centre)
Teicholz	1964 – 2000		-0.72 % (BLS and DOC)
Goodrum Et al	1976 – 1998		0.80 % to 1.80 % (Means and others)

Figure 4

of aggregation, whether we're just aggregating the work at the activity level or way up at the project level or industry level. We look at the practices and whether they're having an impact. We also look at the project environment in terms of weather and labor environment, and at information, which is

the project itself, the characteristics, its complexity, and the sector of the industry.

We have to collect all of that data to be able to do useful analysis on how well we're doing and how effective certain processes and technologies are. Though we may not discuss it here, please be aware that, of course, we're going to have indexes, especially if we're going to measure this over time. We're really talking about measuring over from year to year to year, we have to have input and output indexes that help us compare; then real or basically equivalent dollars, to help us compare apples and apples and oranges and oranges. Much of this

was discussed in the previous presentation.

I thought this was interesting (Fig 4). For a while—again, it was Ted who got me—I was looking at the macro-level statistics. They are contradictory, but I dug up some information from different sources on productivity growth in construction.

Construction Productivity Comparisons Between Countries

Country	Relative productivity in the Construction Sector from The Swedish Construction Federation (US is 100)	International Labor Productivity Growth Rates in Construction Industry, 1979 – 2003 Groningen Centre Data (Harrison 2007)
Belgium	62	1.63
Finland	39	0.71
France	41	1.68
Greece	19	0.68
Ireland	48	1.64
Italy	38	0.95
Norway	56	1.4
Spain	44	1.54
Sweden	76	0.79
UK	20	1.92
USA	100	-0.84
Canada	120	0.4

Figure 5

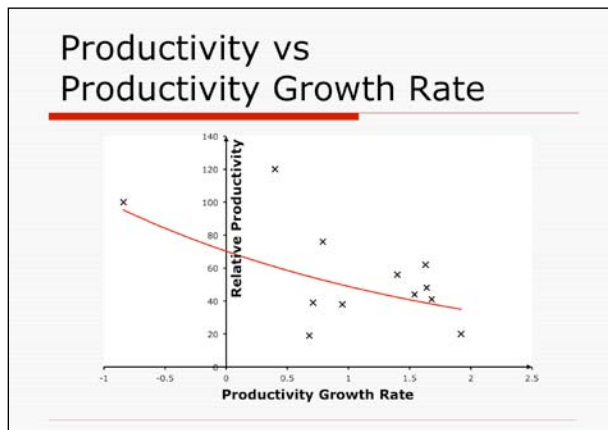


Figure 6

This is construction in the U.S. and Canada, and it was interesting that Canada did pretty well through the '60s and the '70s, but slowed down quite a bit in the '80s and '90s and the aughts (Fig. 4). Everything you look at in the U.S. was saying that the U.S. was not doing as well in terms of annual growth rate for productivity, and of course we're really concerned about that when the rest of the industry is improving 2 or 3 percent a year.

There was, however, a study my colleagues and I did that seemed to indicate that we were actually doing better when you looked at the estimating and activity level data. I revised that study recently with a student, and for the last 15 years, and it's been flat, even looking at it from the bottom up. The bottom up missed a lot of things. It missed a lot of things about regulatory structure and how you actually deliver projects. There was a bright light, controversial, but now even that bright light has kind of been

extinguished today. Chalk it up to early optimism. I'm absolutely convinced we're at a tipping point. We're really going to improve.

Here is another reason not to be too pessimistic (Fig. 5). There's a construction group, the Swedish Construction Federation, which financed a large study showing that the U.S. is still actually the most productive construction environment in the world by far. It has the most productive construction industry for a variety of reasons. I also dug out the growth rates from a Groningen Centre study on construction industries for different countries, and it's interesting. This is statistically meaningless, perhaps, but I plotted relative productivity on the vertical axis and on the horizontal axis productivity growth rate. What I was interested in here—as you see, the World Bank does studies like this—is what is a very productive Tier 1 country. Can we really keep the productivity growing at the rate similar to China? Generally, it said no, and it looks like this is the same sort of thing we see in construction: a higher base productivity means you're probably going to have a slower growth rate, but at the same time, there's quite a bit of variation, so it doesn't preclude having a growth rate (Fig. 6).

You can see that, for example, Canada and some of these other countries are having good growth rates right now. So the message I get from that is even though we've been declining in productivity, we can actually turn that around and there's no reason we can't keep improving productivity at a higher rate even though the current overall productivity is good.

To view the report on this presentation in its entirety, please see Appendix H at www.esdinstitute.net.



The CURT Tri-Partite Initiative

Robert Pleasure, JD

Attorney and Director of Education, Building and Construction Trades Department, AFL-CIO

Dr. Robert Pleasure is Special Assistant to the President of the Building and Construction Trades Department AFL-CIO, and is the Building Trades Director of Education and Training. He holds an MS from the London School of Economics, and a JD from the University of Michigan School of Law. He was formerly Executive Director of the George Meany Center, National Labor College, and Assistant to the President of the AFL-CIO for Education and Training. He directed CPWR, the research arm of the Building Trades, and served as Director of the AFL-CIO Center for Working Capital. Most recently, he was a member of the Department of Energy Review Team in the Obama-Biden transition.

HIGHLIGHTS:

- Pride in workmanship among union labor is not an issue
- There is a large amount of autonomy and leadership by highly skilled workers in the construction industry not present in manufacturing, and those workers need to be personally accountable even when no one is looking
- Training can account for as much as a 17 percent increase in productivity
- Adopting of mutual reciprocal standards of responsibility among all stakeholders
- In general, workers have the same perceptions about what interferes with productivity as owners and contractors
- Logistical problems can affect attitude gravely early on in the job

Thank you very much. This is an unlikely format for a PowerPoint, beginning with “Construction Users Roundtable” as an explanation. I worked with both contractor and owner in developing a set of recommendations to the Construction Users Roundtable tripartite initiative on improving behaviors and conduct on construction jobs that related to productivity improvements. The work we did began with a survey, but I want to back up a second and say that as we began to discuss the project, everybody agreed that no matter what we did in terms of planning, there were some jobs that went very well and some jobs went in the ditch.

And there were construction managers and union representatives there who could not account for the difference. Although many shared prejudices as to why they thought it was, some attributed it on some jobs to a lack of feelings of pride in work. Others said it was a problem of morale. Others said it was poor planning, but we didn’t have at that time any full accounting of people’s views, the people who were responsible, close to the production site.

And we decided as a group—Robert Volkman, who is sort of like a staff director for Construction Users Roundtable; consultant; myself; Larry Wargo, who is from FirstEnergy Corp; and a number of management representatives—to do what turned out to be one of the largest, or the largest up to that point, survey among current membership, building trades representatives, construction workers, and supervisors. We eventually had thousands of people participating in responding to a three-way questionnaire as to what they attributed performance and lack of performance to. And we thought that would be a very useful way of beginning the process of developing changes in practices, which we’re now about doing.

So in light of the injunction Chris gave us [during the introduction], and that many around the room did—“What can we do now?”—we have some ideas, our tripartite group, as to what can be done without significant investment of cash. A lot of it is sort of off-budget regular practices. And I started out by inquiring among people I work with—including President Hill of the IBEW, who we saw a few minutes ago; President Mark Ayers, who’s president of the Building Trades; and others—to see what their view was about the “lack of pride.” And I regularly work with construction workers and training directors and have the same kinds of conversations, and almost nobody said there was an issue of pride in workmanship.

Darlene mentioned at the very beginning of the program that this organization is 116 years old, which is a tribute to the State of Michigan and its foresight. The AFL, which was formed mostly by building tradesmen, is also very old, 130 years old; during those 130 years, many have predicted its demise—certainly in the 1930s they did—and it came back during periods of growth in the economy because it was an essential part of our democratic society. It was formed in the early 1880s, actually 1881, right after a long depression, a depression that was in fact deeper in the 1870s than the one the United States experienced in the 1930s. One thing many people have noted of the construction industry is, at that time and to this day, there was always a term used in the trades: “good mechanic.” And it’s the difference,

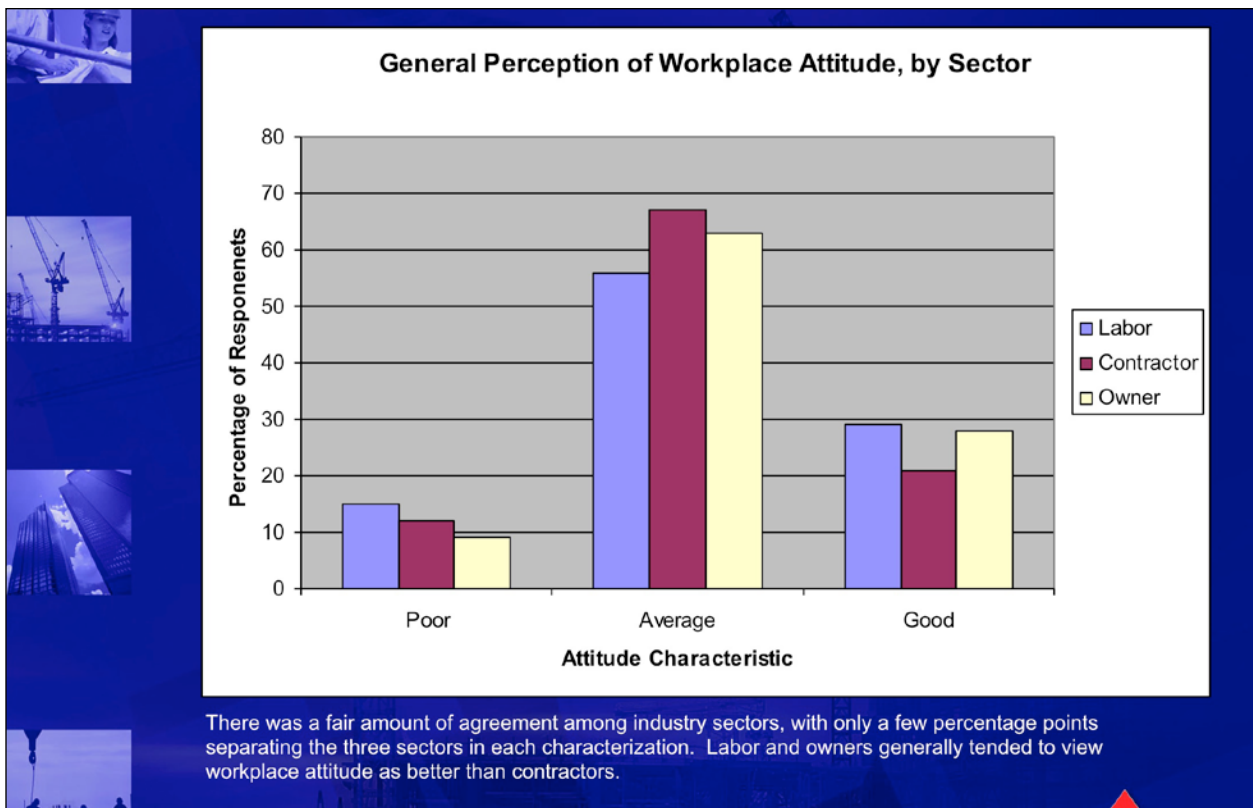


Figure 7

I suppose, between capacity and performance. A good mechanic is somebody who's highly trained, certainly, but somebody who's highly trained doesn't necessarily do the job.

A good mechanic has always been someone, man or woman, who has the capacity and regularly, day in, day out, year in, year out, performs. There was always an understanding among tradespeople and an honor among tradespeople, pride certainly, but honoring responsibility to the craft and to the contractor and to the customer; it was not enough to be highly skilled and you didn't polish your 30-year pin because you had been around a long time. You did it because, day in and day out over the years, you performed at a high level, at a professional level. That's what my instinct was when we began the process, so the question of pride and whether it existed wasn't really the issue. It was about the difference between those projects where there's a high level of performance and those projects, which, unaccountably, at least insofar as people knew, were going into the ditch.

Out of the survey that we did, we developed the "CURT Tripartite Stakeholders Responsibilities," responsibilities of owners' representatives, on-site representatives; responsibilities of contractors'

on-site representatives; responsibility of the union representatives; first-level supervision; and of craft workers. What we were planning to do when we finished the survey was develop those sets of responsibilities and develop training programs around them. We believed this was a question of raising awareness of responsibilities just as we recently did in negotiating the nuclear project agreement that was led by Mark Ayers and representatives of the nuclear energy industry; we felt that each worker, before he/she came to the site, really needed to get a special orientation in which he/she began to understand that it wasn't just in the big things that went on in the project that required high performance. It was in the small things. And, granted, every weld was going to be X-rayed, but it was in the small things when nobody was looking.

That's a unique characteristic of the construction industry and is different from manufacturing. There's an enormous amount of autonomy and leadership by highly skilled workers, and those workers need to be personally accountable even if nobody's looking. How do you inculcate that kind of commitment? We needed to reach all of these stakeholders. It was not simply a question of reaching apprentices and journey persons, but all on-site representatives with some form of

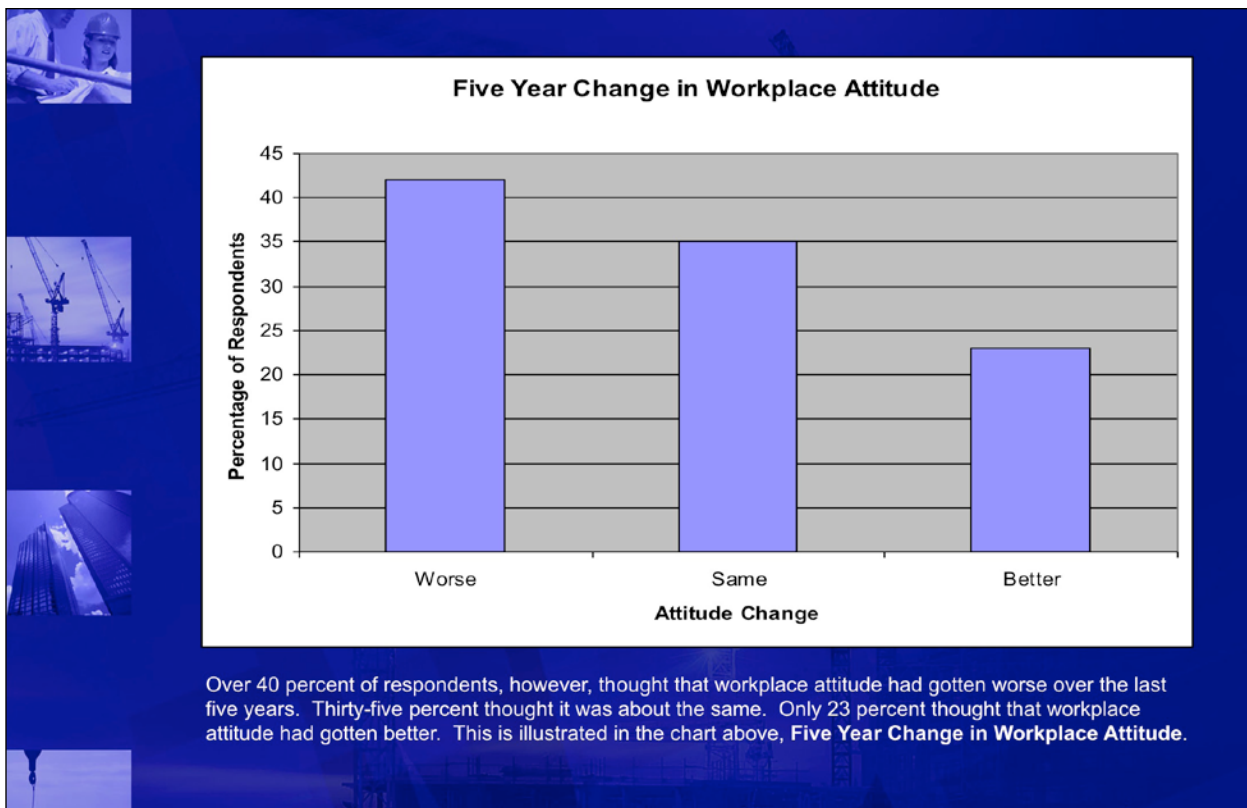


Figure 8

teaching that was reciprocal and integrated, we began with an assignment to me, actually; “Bob, I want you to develop a training program that will give workers a renewed sense of pride about their work.” My instinct, and, as I discovered, other people’s as well, was that there were reciprocal responsibilities that began certainly with owners’ on-site representatives as well as contractors’ representatives, first-line supervision, and construction workers and craft workers.

It’s also important to remember that another characteristic of this industry is training programs, which account for perhaps a 17 percent greater productivity than open shop construction, measured by the largest such study I know of. That training does not only reach first-line construction workers, but it also reaches first-line supervision. All of our training programs do foremen training as well. So when I talk about the building trades and their contractor partners, we’re talking about foremen training as well as craft training.

We went through a process of review and evaluation leading to the survey. The common outcome of this survey wasn’t personal pride or personal sense of responsibility that the three stakeholder parties agreed was at the core of the issue. It was planning; planning that related

intimately to site logistics. Similar productivity literature by Deming, for example, shows that on-line practice change accounts for most of the bump in productivity as opposed to off-line in manufacturing. At least in surveying all three stakeholders, we came up with the same kind of conclusion: it was site logistics that the four parties responding to the survey agreed was at the top. It wasn’t, as many had thought, a question of pride.

I want to make some additional comments to the chart that will show us on this report, which you can get directly from CURT for a couple bucks. General perceptions among those who responded ranged from a little over 10 percent thinking poor; to average, over 60 percent; and good, 25 percent, so perhaps what one would expect (Figs. 7–8). The “General Perception of Workplace Attitudes, by Sector,” if you look at “Labor” and “Contractor” and “Owner,” the pattern is virtually the same, that people were in general agreement. “Five-Year Change in Workplace Attitude” from “Worse,” “Same,” to “Better,” kind of a sense that something needed to be done; there’s a problem here.

To view the report on this presentation in its entirety, please see Appendix I at www.esdinstitute.net.

Experiences in Productivity

Theodore C. Kennedy

Co-Founder, BE&K, Inc.; Member of the National Academy of Engineering and the National Academy of Construction

Theodore "Ted" C. Kennedy is Co-Founder of BE&K Inc., a worldwide engineering, construction, and contract maintenance firm. He retired in December 2008. Under Mr. Kennedy's leadership, BE&K was named one of the top 16 medalist companies out of 300 companies honored in "Companies that Care— The Most Family-Friendly Companies in the United States," and BE&K was chosen by Fortune Magazine as one of the 100 best workplaces in America. Both Mr. Kennedy and BE&K have been honored as inductees into the Alabama Engineering Hall of Fame for their outstanding accomplishments in the field of engineering and construction. Mr. Kennedy holds a civil engineering degree from Duke University, served with the Navy Seabees, and has four daughters, two sons, and four grandchildren. He's a member of the National Academy of Engineering and the National Academy of Construction.

HIGHLIGHTS:

- There is no one-size-fits-all; different rules for different states make innovations like BIM difficult to implement across the board
- Merit shop is more competitive: the value of having good people is paramount
- It is a mistake to cut training first when budgets are tight: down time is opportune for training
- With the right to succeed also stands the right to fail

Just so we get something straight, I am not of that part of the Kennedy family since you've already put me there, and I would tell you I have to disagree because that part of the family made whiskey. My part of the family, we drank it. They obviously made money, we didn't make any money.

The gentleman just before who had asked the question about having a system where there's one particular thing that—all the architects, engineers, everybody—a set of documents we can do. I, too, would like that. I don't believe it's possible.

Just to say a little about that, when I retired from BE&K and we were purchased by another company and I set up my own office. There were only three of us in it, but in looking to how we were putting in the lighting, the area I was in came in and dictated to me what kind of lighting was to be up there in my office, but unfortunately that type of lighting went



dead at about 6 o'clock in the afternoon, deliberately, but I normally was working until 7 or 8 o'clock, so then I had to get up there and wave my hands and everything to make it start again. That was in one area. If, on the other hand, I walked over or put my building three streets away, I was in another community. Their rules were entirely different, and I think one of the things we find today is it's pretty hard to find something that will go from area to area even inside Birmingham, Alabama. I mean, we've got, if I go, as I said, two streets away, I have a different set of rules to follow.

If you look at what we're doing, one of the things we're going to talk about as time goes on is BIM. If you're in one of the states versus another state, more than likely the rules are different there. That's one thing we have in the United States that so far we haven't be able to correct; there isn't a one-size-fits-all on that kind of thing in the construction industry. And I would just say that it's a wonderful thought, but I think it would be very difficult for us, and it does affect how much it would cost to do business, no question about that.

I'm up here today because David Skiven has suggested that I give you a brief background on my background and how I got involved with both him and the idea of construction productivity. I will tell you that I come from a family of construction people. My mother and father were immigrants from Switzerland, my father's side was from Scotland, and both just by accident settled in western Pennsylvania, and they both didn't know each other at the time, but they were very small farms.

During the Depression, my father was looking for work wherever he could find it, and at that time he was the oldest of a family of nine, but he was also the senior person in that family. He was the senior male, so he had to quit school in the sixth grade. He went down to the Pittsburgh area, which wasn't that far

away, and every time they would come out to look for some people they were hiring and they would say “We’re looking for six pipefitters today,” my dad’s hand would go up—I learned this from one of my uncles—and they didn’t hire him. And then the next day they would come out and say “We’re looking for seven carpenters,” and his hand would go up again. And as the week went on, they’d come out looking for 12 electricians, and his hand would go up again. And after about a week of this, one of the fellows came by and said, “You know, you’ve raised your hand on every single thing we’ve said, you can’t be good at any and all of those things.” And he said, “I’m not good at any of them, but I can outwork anyone you’ve hired so far.”

That became his mantra, and the guy said to him “We’re looking for ironworkers. See that building? Do you think you can go up there and get on the high steel?” And dad had never been up in that, but he said, “I can.” And they tested him by getting him up on that steel beam. Of course, there were no safety guards, nothing, and he was able to walk the beam without falling off, so he got the job. From that point on, he was a high steel ironworker, and after that we moved wherever the steel went, and that meant that when Dad saw a train come by that had steel on it, he would ride the rods, which means you go under the train. There were rods that go from the front to the back, and he would lay down on those and then go wherever the train went. And when it stopped and they started unloading iron, he would get out, and then he would go find a job where they were erecting

steel, and eventually my brother and I and my mother, we would follow.

Most of those jobs were pretty short, but eventually Dad went to work for the Rust Engineering Company in Pittsburgh, and we traveled wherever there were projects, which were usually pretty short. I never finished school in the same place we started until I got to high school. One year I attended five different schools. On first thought, that doesn’t sound very good. As it turned out, that was pretty good because if I went to the next school, all of the things I had done wrong in the first school disappeared and I didn’t have to account for them. So that’s not a bad thing.

When I got to high-school age, my mother was pretty smart and she decided we ought to be in one place, so she stayed and we ended up in a small town in Virginia, Front Royal, and we stayed there for the four years of high school. And starting in high school, I, too, went to work for Rust during the summer. Nobody paid any attention to how old you were in those days, and wherever there was a project that either he was on or Rust Engineering had a job, spring break and summers, Christmas holidays, I would go there and try to hire on. Sometimes I would work as a water boy, sometimes as what was then called an ironworker punk, picking up rivets and running welds, joints, things like that.

To view the report on this presentation in its entirety, please see Appendix J at www.esdinstitute.net.



CII RT 272—Enhanced Work Packaging: Planning for Productivity and Predictability

William O'Brien PE, PhD

Associate Professor of Construction Engineering and Management, University of Texas at Austin

Dr. William "Bill" O'Brien is the Phil M. Ferguson Centennial Teaching Fellow and Associate Professor in the Department of Civil, Architectural, and Environmental Engineering at the University of Texas at Austin. Dr. O'Brien is an expert on construction supply chain management and electronic collaboration. His research has been supported by the National Science Foundation, the National Institute of Standards and Technology, Construction Industry Institute, and Texas Department of Transportation. Prior to returning to academia, Dr. O'Brien led product development and planning efforts at Collaborative Structures, a Boston-based Internet start-up focused on serving the construction industry. Dr. O'Brien holds a PhD and an MS in civil engineering and an MS in engineering-economic systems from Stanford University. He also holds a BS in civil engineering from Columbia University.

HIGHLIGHTS:

- Predictability of schedule a cost are extremely important
- A key planning difference for the RT 272 enhanced work packaging process is getting the engineering set up so it supports the field
- If you pay for the planning up front, you get it paid back in spades later on; engineering teams and construction teams need to be collaborating and sequencing the work early
- Contractual language needs to level the playing field for those implementing work packaging

I am reminded it was over 20 years ago when I started in this industry, working on what was called back then 3-D CAD—or, now—BIM, and thinking how that would revolutionize the industry, and realizing it's been 20 years and maybe, finally, it's here. And so we are an industry where ideas explode and take hold, but it's also important to realize it's not the technology and process. It's about people and it's about trust, and what I have to talk about to you today is a recommended process model that takes technology and trust to work.

The good news, though, is that by having a good model, it supports the better use of technology and supports trust and transparency between stakeholders. Enhanced work packaging, which is sometimes called workface planning, was originally developed by the folks in the Construction Owners Association of Alberta. It is also compatible with lean construction.

Realizing these efforts, the Construction Industry Institute (which has been around since 1983 and was founded at the University of Texas by Richard Tucker) chartered a research team to answer two questions. The first: what is best practice today? The second: what can be learned from the current efforts, and what is a better-best model to advance the industry? And so what I'm talking about today is a report that's now available and reported at the CII annual conference and also available in publication, which you're welcome to download.

I'm really here as part of it. I'm not here representing myself. I'm here as a member of a team of people from around the industry who spent two years on this research team, and these are folks who have depth of knowledge both in the field, but also on the engineering side, and, importantly, they represent both owners and contractors, as well as a few key vendors.

TRADITIONAL WORK PACKAGING

Everybody plans their work and every project does that, and the question is how effectively they do it given current standards. We've been planning our work effectively or less effectively back to the pyramids, and the real problem in our industry is it's often accomplished informally and inconsistently and often done too late in the field where there's no advantage to pre-planning. What enhanced work packaging is about is trying to take a holistic perspective to planning by starting all the way back at project definition, figuring out how you're going to do the job work, breaking that structure up, and then turning that into productivity in the field. You don't want field craft people doing the planning as they're doing the work, but rather let them have more effective face time and tool time in the field. That means let's do that planning with them collaboratively, but earlier, and let's put the structure in place, so the job is planned consistently all the way through.

We know that labor productivity is important, and I won't belabor this point. We've talked about this. The key is that things run together, and not only is labor productivity going to give you better cost, better schedule, but it has beneficial effects on safety and it has beneficial effects on quality. And the results really are not just about cost, but they're also,

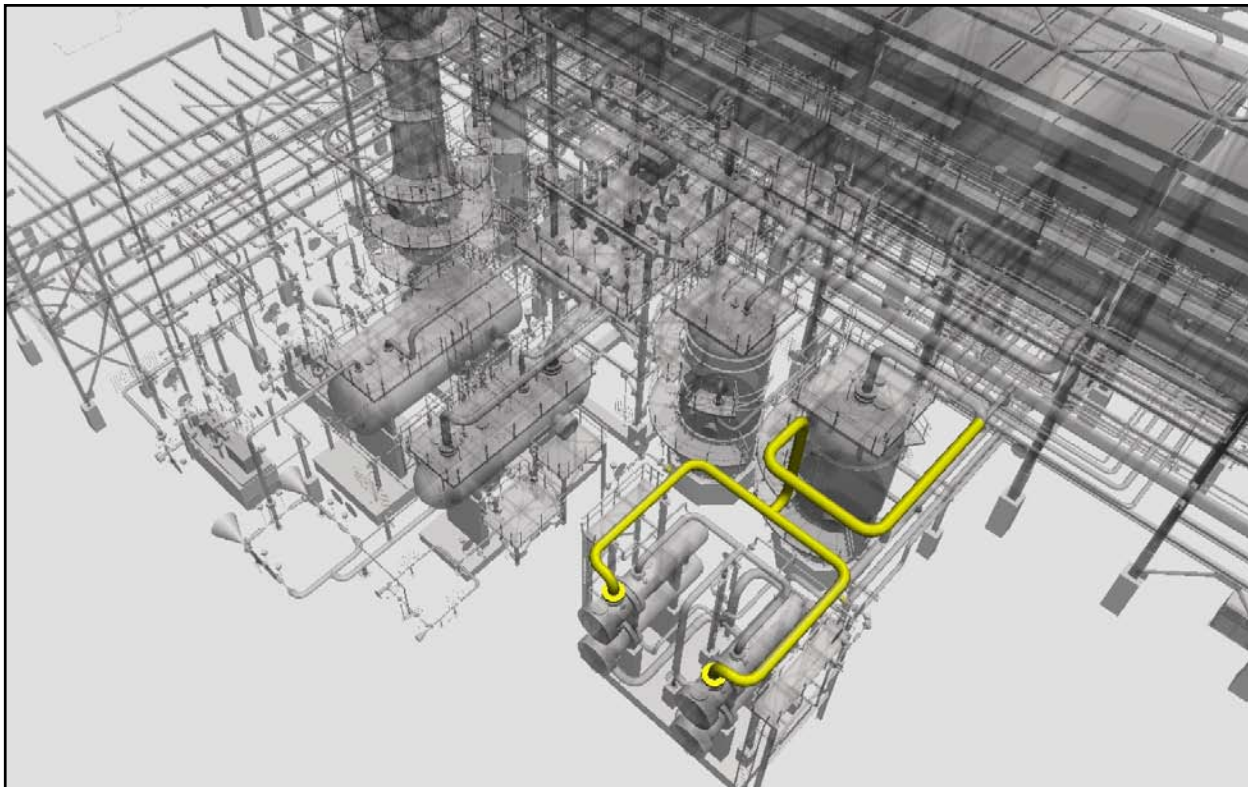


Figure 9: Work Package Hierarchy

importantly for owners, predictability: predictable schedule, predictable cost.

The evidence from a number of case studies—I would say the balance of them in the industrial sector but some in the commercial sector as well—is that enhanced work packaging gives you the best, better planning to support the field all the way through the project. It’s about a cleaner and safer job site, it’s about better alignment from engineering to construction, and maybe that’s the most important thing. It’s really novel compared to those whose efforts focus solely on the field, and with that, a whole bunch of other benefits.

The CII RT 272 research team found several opportunities for the industry. One of them looks at differences we have, everybody thinks differently, and with that there is inconsistent terminology. It is part of what the team reported on that is being offered to the industry as the standard definitions for this work, a recommended process model, and recommended documentation. And so what the team delivered is a common language, some specific implementation tools to help you assess, and some supporting case studies.

Let’s talk definitions. There is a set of these in our report. I want to talk in particular about three of them. Work packaging as we know broadly is

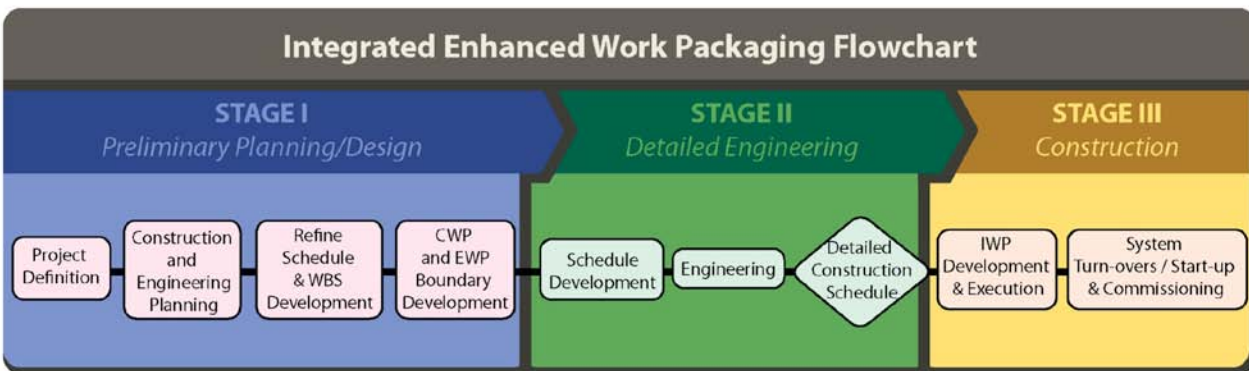


Figure 10: Recommended Practice Model (overview)

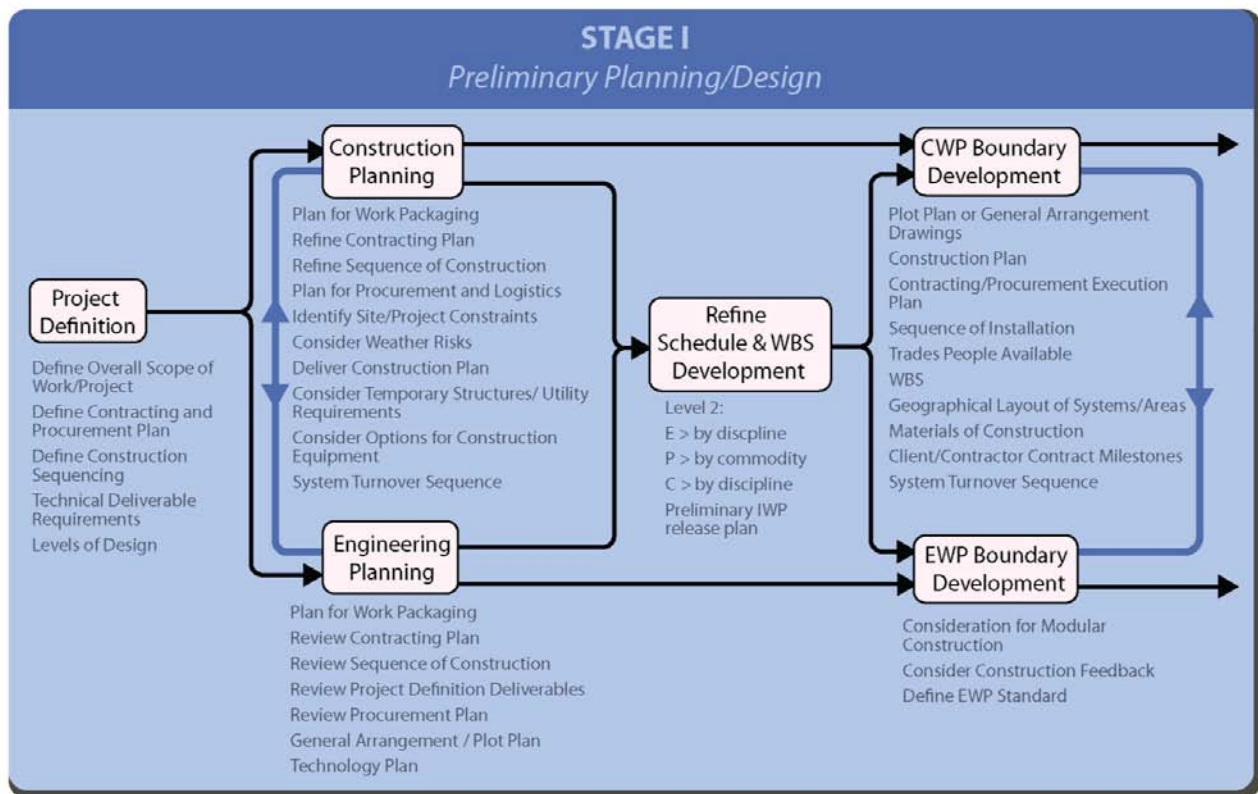


Figure 11: Stage I—Preliminary Planning Design

about splitting a job up into different chunks of work that are performable. The problem is that's not a definition you can operationalize easily. We think there are really three key concepts to effective work packaging. And this is where the real enhancements come with our current work. You have the concept—and I'll start from the bottom—of an installation work package, which is that small chunk of work in the field depends on the size of your job and your core technology. We think of that as one crew week or a shift week of work, or around 500 hours. It can be smaller or bigger, but what is a manageable amount of work for typically one trade.

Installation work packages are contained within a construction work package, which can be either an area of the job or associated with a bid package. What's really novel to effective work is the explicit definition of an engineering work package. A designated engineering work package belongs inside a construction work package and has deliverables so you can then work backwards, and say, "Let's get engineering delivered to construction on time."

The key planning difference for the RT 272 enhanced work packaging process is really about getting the engineering set up so it supports the field. And it's a challenging activity, but one where there's great area for improvement.

You can see a work package hierarchy here (Fig. 9). [Video played] Here's an industrial plant, overall project. This would be a construction work package. An engineering work package would be a discipline within that CWP. And, of course, you're going to have construction work packages that are going to link. It's key, it's important to have an EWP as part of a CWP, supporting it. And, finally, an installation work package here might be, again, one crew for one week roughly to put this pipe school in place.

Therefore, we have a recommended process model (Fig. 10). We have it in three stages that go from preliminary planning and design to detailed engineering to construction. We were very careful here not to use language like FEP or FEL 1 or 2 that are specific to certain industries. Really try to be as general as possible. So I want to note the relative size of the blue box here. This says that enhanced packaging is about doing things in the preliminary stages of the build, and this is where there is an opportunity for contractors to add value, I know there are a lot of owners in the room, too. This is an area where owners need to get involved and make decisions early on to support the flow of the work, because if the owners do not help in making those decisions, there's no good environment for those decisions to be effective, then everything else falls down and you're not getting the full benefit of early planning.

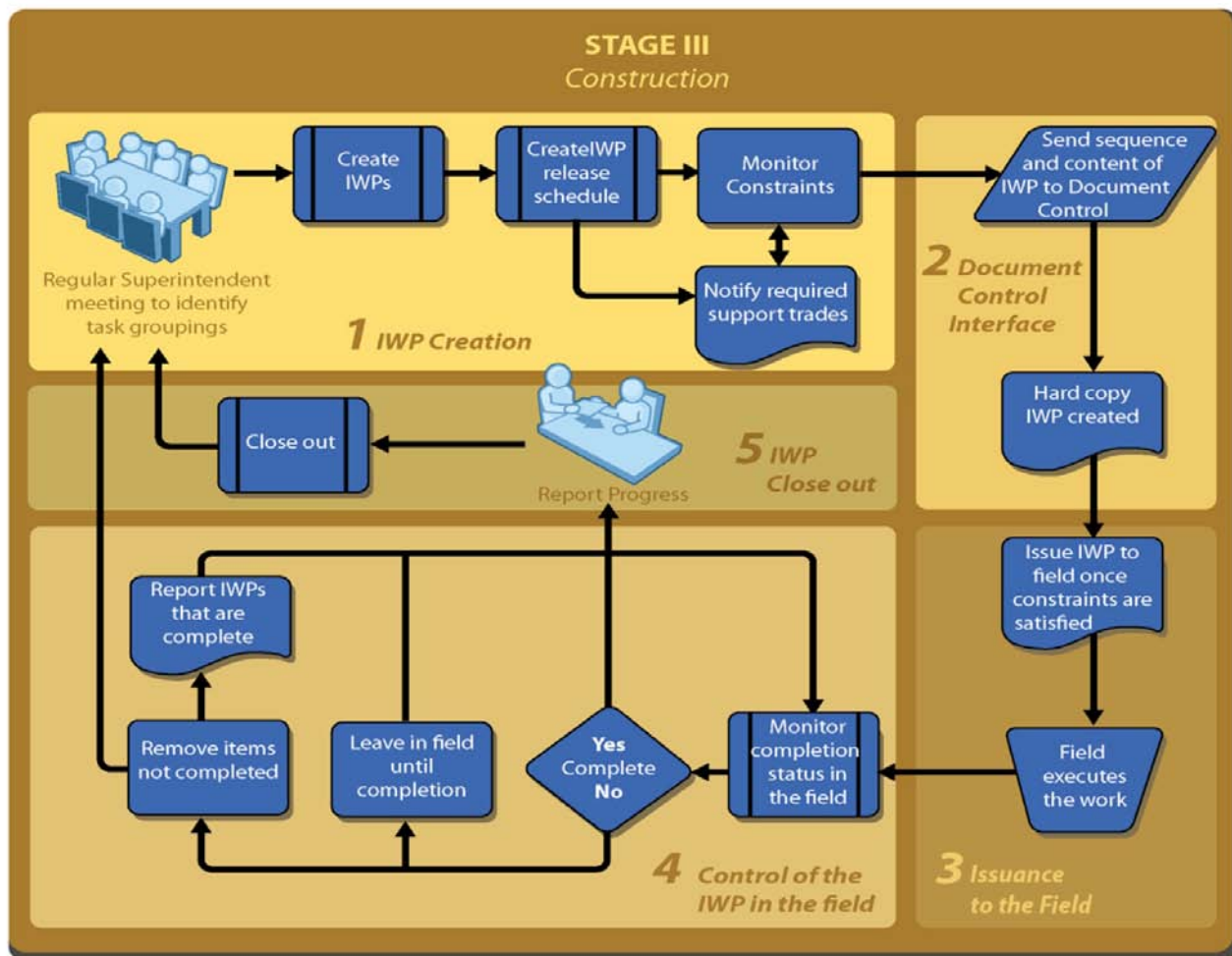


Figure 12: Preliminary Planning and Design

I'll go through very briefly each one of the boxes. The report has about 50 pages of discussion about this process model and another 50 pages of supporting tools and references (CII IR 272-2).

You have—the contractor may not even be on board yet—the construction expertise on hand in-house at the owner level to decide the construction sequence. Also the level of detail we're going to do engineering design down to. Is it three-quarter inch ISOs? How far down are we going to go so that we'll effectively support field installation of the package on the back end? And then notice the need to have construction planning and engineering planning done parallel in the planning stages. So rather than have a project where engineering does work as efficiently as possible—and this is one of the problems where we have contracts where the engineers do their work separately, we need to structure engineering sequencing. It's about having an engineering team and a construction team that are cooperative and collaborating and sequencing the work effectively early on.

A message here to take home for the owner organizations that do not operate this way is to start thinking about doing that. Even if you want to have a contractor on board after the design is done, get the expertise, hire it, hire somebody in-house, rent somebody to provide this expertise early on.

Finally, in construction we have five phases, but I won't show each of these little boxes in detail (Fig. 12). There's another set of more detailed flowcharts that provides a sequence for detail planning installation work packaging to release to the field through to actual completion in the field and follow-up. This is a process that is very constraint-management based. It's very compatible with those of you familiar with lean construction, or the lean manufacturing principles of defining the work, putting a flow in place, and then don't release the work until all the preparatory work is done and is all there.

To view the report on this presentation in its entirety, please see Appendix K at www.esdinstitute.net.

Modular Build/ Pre-Fabrication

David Ciuffoletti

Vice President and Director of Paint and Final Assembly Systems, Dürr Systems

Mr. David Ciuffoletti has over 30 years' experience in the automotive industry with Dürr, serving in a variety of roles and responsibilities. As a VP and Director of Sales for Dürr in North America, he has been responsible for business development and sales and marketing for business units, including paint systems, final assembly systems, application systems, and environmental and energy systems. Mr. Ciuffoletti also has ten years of experience in project management with Dürr, where he managed numerous projects ranging in individual value from \$20 million to in excess of \$200 million. This lent to a solid and diverse background encompassing engineering, estimating, manufacturing, and execution, all with "Customer Focus and Relationship Building" at its foundation.

HIGHLIGHTS:

- Modularization shifts the build from a reactive stance
- Enormous quality and safety improvements are possible using modular build because
- the systems are manufactured in a controlled environment
- Modularization tempers varying and unexpected final costs
- From logistics and pretested standpoints, Michigan is perfectly positioned to capitalize
- on being a center of modular build export

Thank you and good morning. My symposium topic is "Modular Build/Prefabrication." The way I've compiled my presentation is more linear in the advances in manufacturing techniques, some tools that have helped us advance in the industry, as well as some case studies. And, most importantly, I want to be able to bring it all back and link it to the symposium's mega question, which closes the overall loop.

Dürr, for those of you who aren't familiar, is a manufacturer, so everything is from the perspective of manufacturing. From that standpoint, initially in the past, the perceptions with modular build, the mobile prefabrication, used to conjure up some visions of mobile homes, something temporary or manufactured products of lesser quality. Mindful of

that fact, this perception doesn't apply to all markets and segments, and it's a perception obviously needing to be debunked from that perspective. It wasn't that long ago—I'm sure most of you in the room can testify to it—when quantity trumped quality and production was king. I think we all realized that at times. If manufactured enough, the sheer volume alone would compensate for the quality shortcomings. The consumer was being conditioned to accept some of these status quo conditions. So in a time of plenty, issues like safety, manufacturing efficiency, world-class quality, maintainability, modularization, and even the environment were unfortunately not high on the priority list.

But from those days of hundreds of engineers bent over drafting tables, clay models, physical beta systems, smoke bombs for air flow characteristics, all of those done in an effort for R&D and simulation, we now have today's terabyte power computers and industry-specific software that are demonstrated here. What took weeks and months—along with numerous engineers—now takes minutes by basically one savvy computer operator, all of this lending itself to some of the efficiencies we have at our disposal today.

Despite that, the end customer really wasn't satisfied just on those efficiency gains—and we've realized that firsthand—and his expectations were much higher than just efficiency gains. He also wanted to have, at least on an executive level, benchmark information, operational information, comparisons, operating costs, predictable performance indicators, all of these things at his fingertips to be able to make decisions, all of this in preparation for a project that was really just at its infancy in a lot of stages. So it's all pre-planning.

What we did, at least if we were recognizing this, is experienced it firsthand and developed, researched, and looked at something as simple as Lego systems. Legos, at their simplest form, are a modular best practice that we—and you can look at it on-line—where we've taken those simple tools and added the sophisticated tools you saw on the previous slide, along with some other intuitive tools, to be able to give a cradle-to-grave powerful tool, and we call that the "Snap Planner." This is all done in a modularized environment.

From taking a standard 2D layout development and morphing that into the 3D aspect for modular products and adding to it the characteristics of those modular products, and then linking it to an overall workable layout, all reconfigurable in a matter of minutes, and then lending itself to what we have today: the Snap Planner tool and all of its outputs. It's sophisticated, operational, and gives you longevity

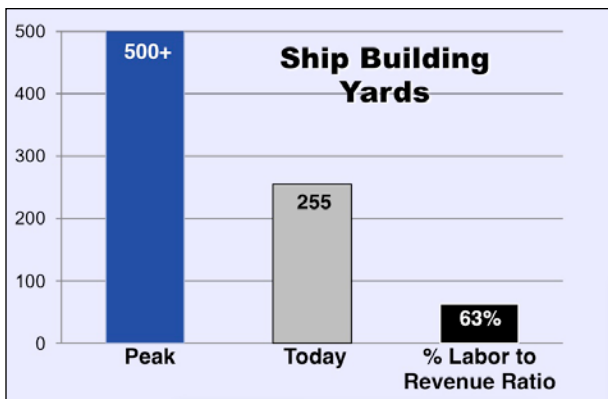


Figure 13: Advances, Ship Building

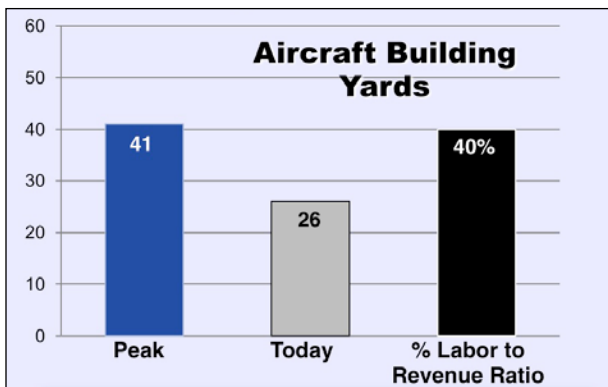


Figure 14: Advances, Ship Building

information, characteristics of each one of these modular components. It's a very powerful tool. It's cradle to grave, with the outputs ranging from layout comparisons, manpower analysis, and forecasting energy consumption, your carbon footprint, consumables—just to name a few—and all of this in a foundation of where we're at today in the overall planning and development of modularization and where the industry has really taken itself.

Shifting just a little bit here, what I've done is I've basically jumped into other markets here, this one being in the ship-building industry, but it wasn't that long ago they were suffering with some antiquated systems and using some of these tools we have today. They've advanced, and you can see that the majority of these advancements has occurred over the past five, ten years. It hasn't happened overnight, but the majority of these advances are accelerating as we move forward year to year (Fig. 13). Using some of these 3D CAD, CFU modeling simulations, the industry is modularizing itself. And you also see they're suffering, like all of us, in basically a reduction in size, from shipyards that used to be in the country of upwards of over 500 ship-building shipyards around the country that have been reduced to nearly half. What they're addressing is that percent-labor-

to-revenue ratio. It seems very high, basically sitting at a 63 percent level; but again, modularization, some of these characteristics and tools will be able to improve upon that.

Moving forward, similar to the ship-building industry, the aircraft industry has also advanced with the tools and production improvements and efficiencies that some of these software tools have provided (Fig. 14). And like the ship-building industry, you see a 40 percent labor-to-revenue ratio; again, emphasizing the opportunity that still remains in that industry to be able to improve efficiencies, gain on revenue sharing. And another note to compare this to when you're looking at this as compared to automotive, for the record, the automotive is sitting somewhere around 28 percent labor-to-revenue ratio, which although is a benchmark in manufacturing, there's still room for improvement.

One other note, and we've realized this firsthand in aircraft, is they're striving these days to move from what used to be a plane a month to a plane a day. This is being experienced on the F-35 Strike Fighter, and they're using the lessons learned, the lean production methods from automotive. There's a lot of counseling going back and forth between industries, and some of that linear approach for production, the Henry Ford production system, is being shared and implemented in modular formats within the aircraft industry. So it brings to this paradigm shift the subject of: why modular build? From a Dürr perspective, some of those things are quite apparent and I'm sure all of us can share in it, is the inconsistent end product quality; the regional subcontractor expertise; the inconsistent labor markets; fuel costs on the rise; the mounting rework associated with sending loose materials to the job site; missing or lost components out in the field; safety incidents—that was brought up several times through some of the previous presentations—and then the varying costs, never being able to get a handle of what that final expected cost would be. An effective solution obviously was paramount. Again, from a customer perspective and the long-term goals and challenges, they were basically clear. Although it seemed daunting, remember, it wasn't that long ago from a customer perspective that most of the product design and the componentry was done by the end customer, along with his third-party process engineering firms.

The challenge was being put onto the suppliers. In this example, basically Dürr, where we wanted to take on this industry challenge of taking on more project responsibility; more risk associated with it; and also being proactive in a lot of these designs in modularization versus being reactive, which we

suffered through for many years; and being more of a solution provider. In simple terms, at least in our world, our customers are looking for something that was modular and basically on wheels. And when I say on wheels, this is the mobility of those products and not becoming monuments at their particular site.

The challenge on this modular build is to go from this right here, which is loose material on the job site, and providing an end product that would take us here. Basically the same thing. I mean we're talking about loose material that was basically cut to length, shipped to the job site, and changing that paradigm to a completely fabricated product that can be installed, it's scalable, and also transferrable from site to site and not dependent on the specific job site from our customers. So the challenge was there. And, going through that, I've put together a little animation. [Video plays] This animation gives you the concept.

This is real world, where this is a work cell within an assembly system, automotive, which comes out of the crate preassembled, all cut to size, all scalable, all of it nondependent on the building itself, and allows itself to be erected in record time, as well as very consistently as far as the quality, and utilizes or also incorporates all the necessary utilities and data information systems and the line-side ability and the expandability within each segment (Fig. 15). You also see here being demonstrated the scalability of

the system. Again, it's not dependent. This could be in a Wal-Mart warehouse, bar joist construction; this is all floor-mounted. And given the conditions these days, customers want to have an asset that's mobile. This allows that to happen. So this is modularity in a case study that is transferrable and also repeatable in its quality. The net results from that, which varies from site to site, give you at least a perspective on the kind of result.

Obviously you can tell just by the way it goes up that in the field, it's a very efficient system; the quality improvements because of the system is manufactured in a controlled environment; and the safety improvements where you're not hauling steel and working above each other, and safety incidents were reduced considerably. Some of those were reductions in hours, and when you look at something that was manufactured and the majority of it being implemented out in the field, you're dealing with higher costs. When you're modularizing, most of that is in a controlled environment and lower cost—a cost center within your own shop—and reducing that significantly out in the field. The net result, again these numbers vary, but anywhere from 16 percent reduction in total hours, obviously impacting 28 percent in the overall cost. That was what was realized in that particular case study.

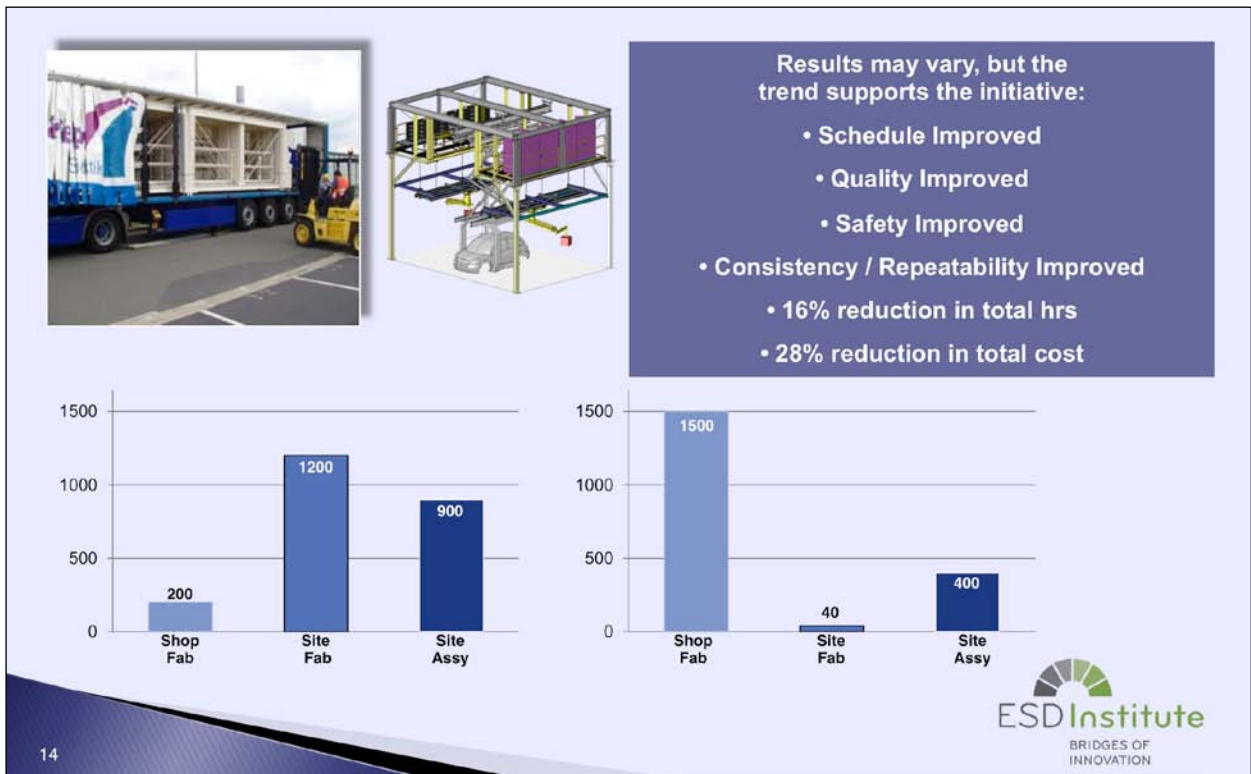


Figure 15: Modular Build Case Study

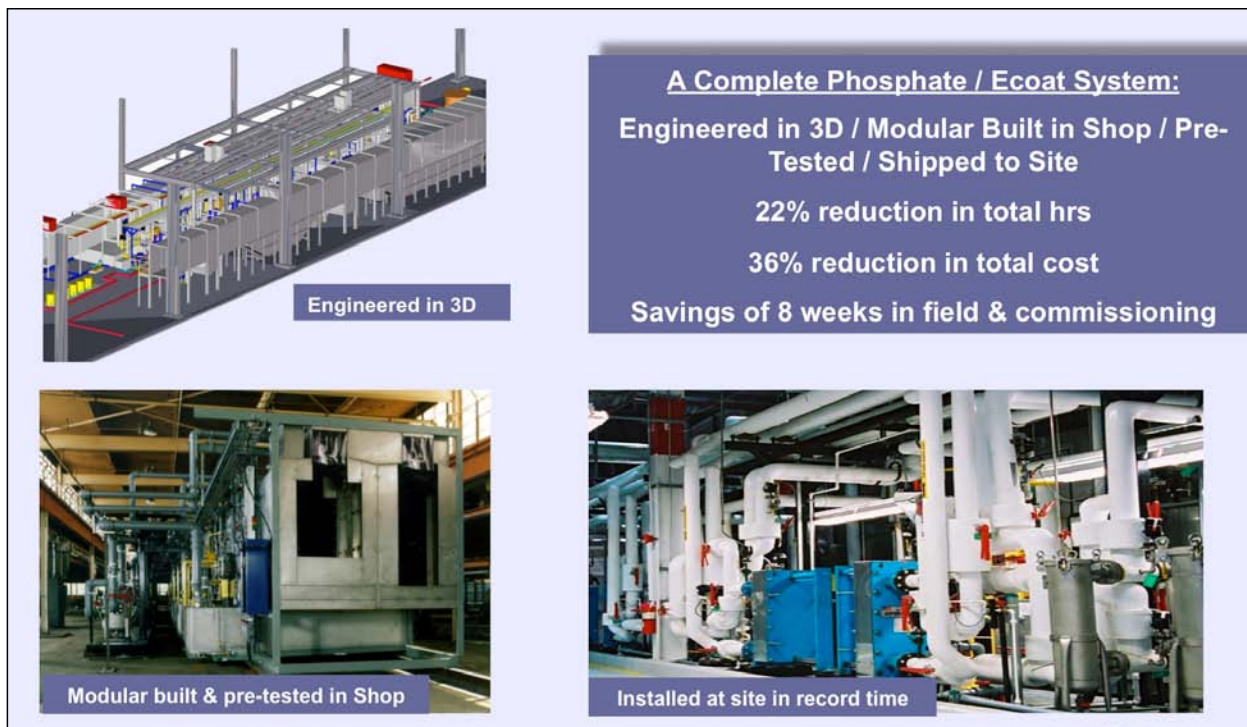


Figure 16: Dürr “Mod Case Study with Harley-Davidson

Here’s another example (Fig. 16) on a Harley-Davidson system we installed, which was normally loose materials, components shipped to the job site and assembled at site, but it’s called a pretreatment system for a complete line at Harley-Davidson, all pre-engineered in 3D. It was manufactured in our shop and then pretested and shipped to the job site. Everything was done in a controlled environment and modularization, so all the components, utilities, everything associated with it was done in the shop and broken down into transferrable items over-road to the end customer’s site, again rendering those sort of numbers in total cost reduction based on our historical installations where we sent out loose components and materials to the job site.

Moving further, some of the items and some of the challenges to improvement—and I can’t emphasize this enough along the stakeholder lineage—are the early commitment from the engineering design through the manufacturing through the installation because it does affect you out in the field. So early commitment is in the design and the design stage on what is going to be modularized with all of its influences that could occur. From transit, transportability, from weight restrictions, permitting throughout the different regions, all of those things have to be taken into account to be able to get the full value and payback from it.

In addition, from a logistics standpoint, looking at this from a pretested standpoint, obviously over land is one option, but there are also options especially in Michigan with a lot of deepwater ports, upwards of 38, that can be used for transportation. And I’ve got one of those demonstration slides in my presentation here to give you that example.

Here’s a challenge for you: not that long ago, not only in the automotive field, but when you look at an overall assembly plant, you’re looking at this marvel of engineering that manufactured these automotive products that we use every day, but what about the systems internal to those manufacturing facilities? Who are the customers or the suppliers out there supporting those working in the facility, and how can we bring modularization to its Nth degree to be able to meet some of these robust schedules and cost targets? Dürr was challenged with building three simultaneous automotive facilities, paint facilities, for a particular customer. And the challenge, as you can see, we want a low-cost, world-class timing, a flexible/scalable system, a very safe work environment for the workers, as well as the green approach. We want this to be as green as possible, so operating costs, carbon footprint, all of those things come into the equation (Figs. 17–18).

To view the report on this presentation in its entirety, please see Appendix L at www.esdinstitute.net.

The Challenge: An Automotive Paint Facility - 1 Plant 3 Locations Simultaneously!



Customer Wants:

- Low Cost
- World Class Timing
- A Flexible / Scalable Process
- A Safe Work Site
- "Green" Less Operating Cost



Figure 17: The Challenge

The Plan...

Applying Good Business Sense, Innovative Modular Solutions with an Industry Leading Partner



★ - Key to Success

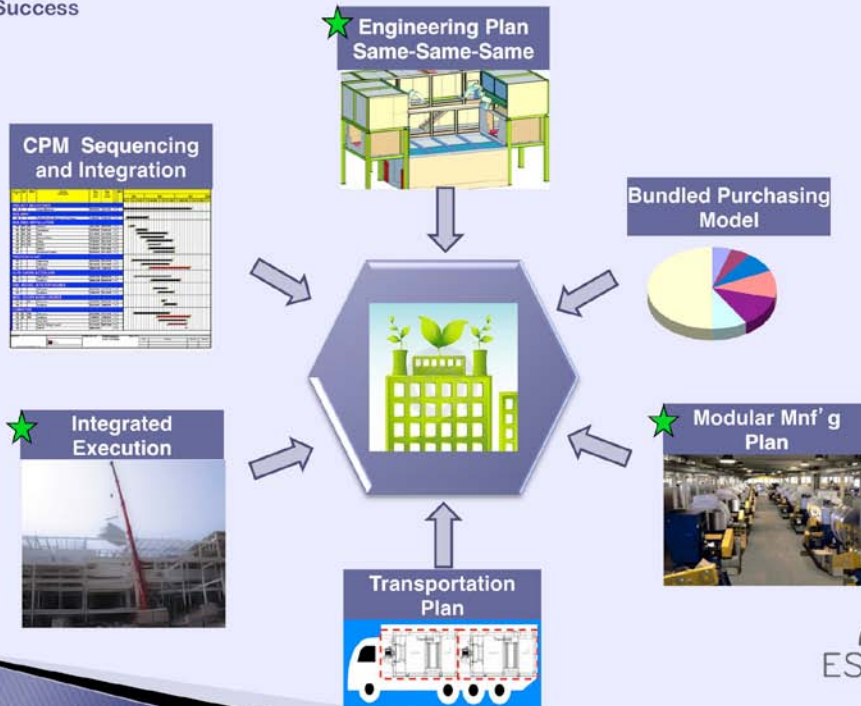


Figure 18: The Plan

Eliminating Waste in Construction

Robert Mauck, AIA, PE, FESD

Vice President of Virtual Design and Construction
Ghafari Associates, LLC

Robert (Bob) Mauck is Vice President of Virtual Design and Construction for Ghafari Associates, LLC. He leads the firm's development and application of new design and delivery technologies. Under his leadership, Ghafari has become a forerunner in the use of 3D advanced technology, including deploying 3D enabled lean, Digital Factory and Building Information Modeling processes across the supply chain. Mr. Mauck regularly presents at national forums on how BIM enables improved workflows across integrated teams. He also co-authored a whitepaper on Integrated Project Delivery with Sutter Health. He is currently serving as Principal for Ghafari's Nationwide BIM IDIQ with the General Services Administration. In 2010, he was Co-Founder of the Lean Construction Institute Michigan chapter and was a contributor to the publication *The Commercial Real Estate Revolution*.

HIGHLIGHTS:

- There is significant opportunity for breakthrough gains when we move beyond the stick-build mentality
- Process change has to be owner-driven
- Collaboration and co-location, along with shared risk and reward leads to interference avoidance and accelerated decision-making, which leads to overall cost and time savings

I'm not looking to go into lean basics. I'm actually surprised this image didn't come up through one of the other presenters, but waste in manufacturing as compared with waste in construction. And obviously a 26 percent waste in manufacturing is not good, but when you look at construction and you're a lean purist, 57 percent waste (Fig. 19).

This image compares workflow in a 2D environment, which is paper-based, with a 3D enabled approach (Fig. 20). And what we did not realize at the time we started doing this, in the orange

color there essentially is what the consequences of a 2D paper-based model. You know, those are changes in the field, and it's that big bubble off to the right there, as contrasted with if we can bring this all together as an integrated team, we can resolve those field issues within the model environment.

And here, the same thing: 2D paper-based contrasted with when you bring the integrated team together, eliminate the waste, now we have the opportunity to aggregate datasets and integrate across the one continuum...achieving the virtual build.

Here are three benchmark series in the industry right now. One is GM, which goes back to 2004–2008, a series of ten projects that were design/build, but had IPD principles at the time. The GSA, I'm going to talk about that in a second, which is CM based. And then there is Sutter Healthcare, and my colleague—or customer, actually—Digby Christian, who keeps driving improvement on the southern Castro Valley project, which is pure IPD. Eleven parties signed that contract (Fig. 21)

What do these series have in common? And if you look at the image here, they're all collaborative; typically they're co-located, shared risk and reward with a heavy focus on risk mitigation, a combination of lean, BIM, with an objective to achieve the virtual build. And I don't mean a coordinated solution at design, but a virtual build that is deliberately moved from design to fabrication to construction via the 3D model. Essentially, the last bullet there, the build-to-the-model mandate, can be attributed to, I think, Jack Hallman from GM, who was the gentleman who came up with that as a target (Fig. 22) All three of these series have an aggressive outreach in terms of improving the industry; what can we bring back to the industry to improve it?

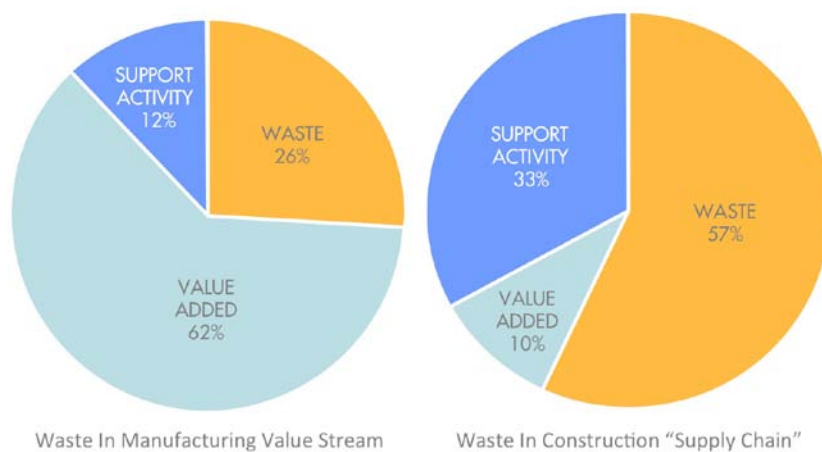


Figure 19: Waste in Manufacturing vs. Construction

The GM project had commonality with the other projects: process improvement. How do you objectively identify current state constraints within a design delivery system and then identify future state opportunities? There was a heavy dose of mapping within the GM series. Especially for moving structural steel directly from the engineer, Ghafari, on the project, to the structure steel fabricator via the model.

We've done this with probably seven or eight major fabricators in the U.S. and it works every time with a little preparation, but with steel mill orders, which used to be about 120 days, was reduced to as little as 10 days on these projects. Weekly model integration sessions are typical for all of these delivery systems, and again, a heavy use of BIM. Select GSA projects are adopting many of the same principles: "integrated team," weekly integration sessions,

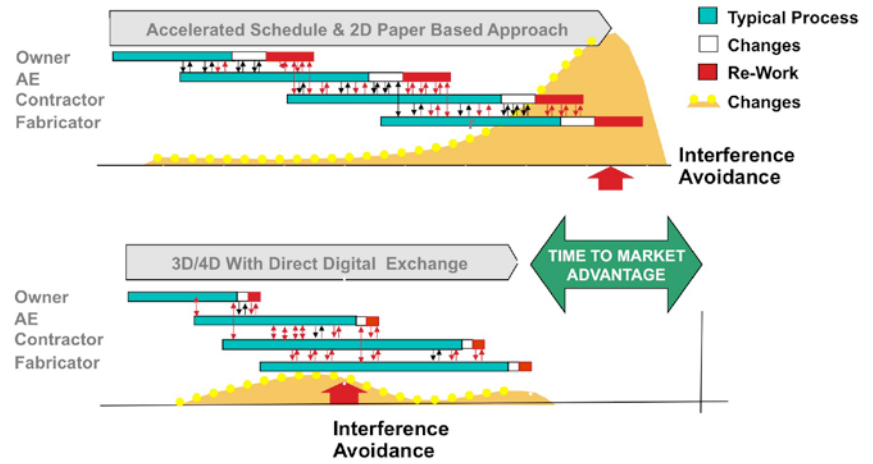


Figure 20: 2D Paper Based vs. 3D Lean Enabled

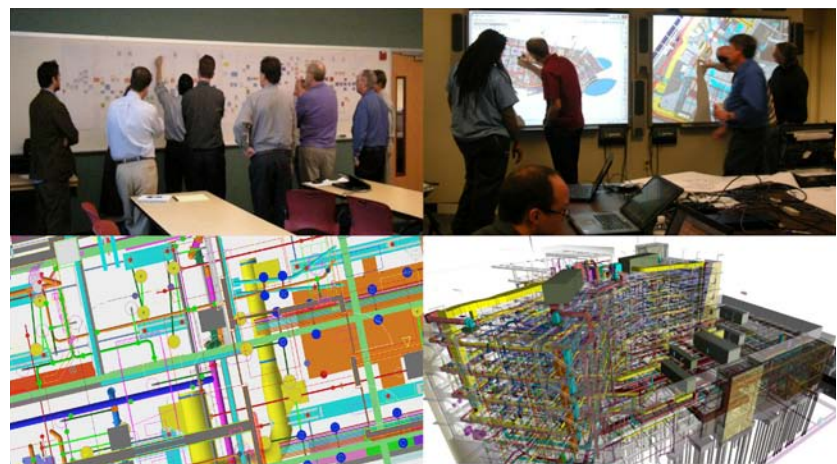


Figure 21: Sutter Medical Center

- Design / Build* series of 10 projects
- Direct Digital Exchange (DDE) to accelerate steel mill orders
- (10 days vs. 10 + weeks)
- Up to 26% faster delivery
- Up to 15% cost reduction from initial cost model
- Weekly collaborative "Big Room" model integration sessions, collocated team
- 24/7 data access to stakeholders
- No change orders from field coordination issues
- The Virtual Build
- Build-To-The-Model Mandate

*With Integrated Project Delivery principles

Figure 22 Results: GM Digital Factory Series—3D-Enabled Lean Approach

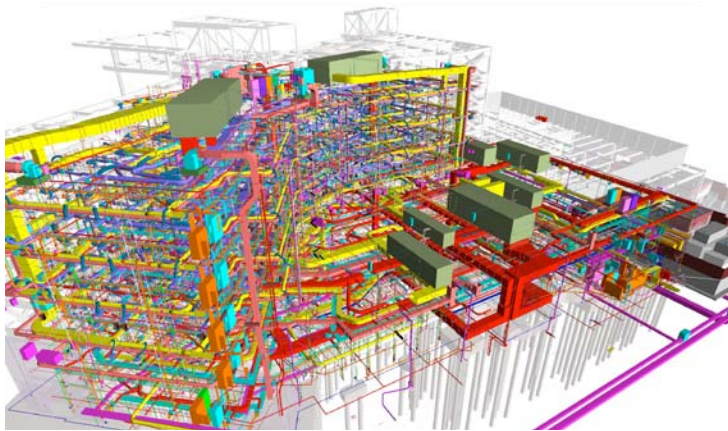


Figure 23: Sutter Castro Valley: The Virtual Build

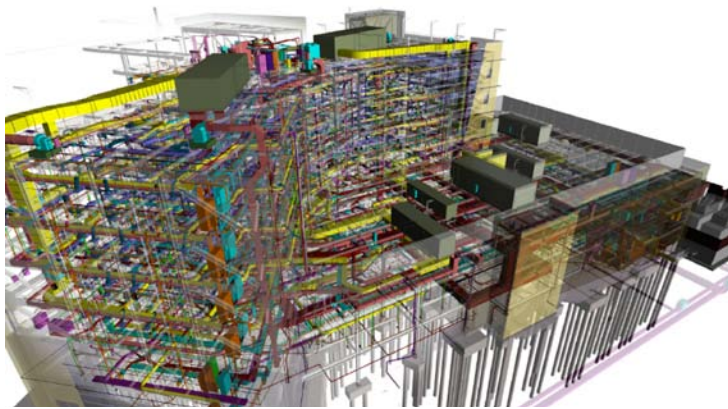


Figure 24: Sutter Castro Valley: Build-to-the-Model Mandate

the use of the BIM to the extent on this particular project, the interference avoidance was tracked floor by floor before it was to fab install.

Sutter Castro Valley has achieved some very encouraging metrics, and, again, mapping of a combined team workflow and the achievement of the virtual build and in large part the 3D as-built before construction. And then, as deliverable moves from design through fabrication, through construction, that model data shown here on the lower right and then the larger down here is approaching the 3D as-built before construction (Figs. 23–24). Looking at the result of the GM series, I'm not going to read through all of these, but again, a series of ten projects. We were a partner with Barton Malow and some of the other partners attending today. These were basically design/build, with co-located teams so we could accelerate decision-making (Fig. 22) This resulted in up to a 26 percent faster delivery. I think an average 20 percent, with cost metrics averaging 10 percent first cost improvement across all ten jobs.

Budget	<ul style="list-style-type: none"> • Field Change Orders: 0% • Steel Mill Order Timing: 10 Days • Opportunity for Breakthrough Efficiency Gains: Numerous 	Actual \$
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BIM / Lean Enabled Design / Build (40 Weeks)

Budget	<ul style="list-style-type: none"> • Field Change Orders: 3-5% • Steel Mill Order Timing: 40-60 Days • Opportunity for Breakthrough Efficiency Gains: Little 	Actual \$
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Design / Build Fast Tracked (50 Weeks)

Budget	<ul style="list-style-type: none"> • Field Change Orders: 5+% • Steel Mill Order Timing: 70-80 Days • Opportunity for Breakthrough Efficiency Gains: None 	Actual \$
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Design / Bid / Build Fast Tracked (60 Weeks)

Figure 25: Delivery Comparison

No.	Project	VDC Score
1	Sutter Health Castro Valley Medical Center	80%
2	Medical	71%
3	Federal Building	70%
4	Residential	66%
5	Medical	57%
6	Lab	54%
6	Office	54%
6	Federal Building	54%
9	Medical	52%
9	Office	52%
9	Lab	52%
12	Federal Bldg.	49%
12	Theme Park	49%
14	Medical	46%
15	Federal Building	45%
16	Federal Building	44%
17	Federal Building	43%
18	Courthouse	39%
19	Courthouse	38%
20	Federal Building	37%
20	Courthouse	37%
22	Federal Building	36%

Used with permission from Stanford University – CIFE

Figure 26: GSA Outreach

Weekly model integration sessions meant no change orders from field coordination issues on any of these ten projects. Field coordination

issues were resolved within the model before this project was built. These projects achieved the virtual build. They adhered to a build-to-the-model mandate.

Here is a real quick comparison between delivery systems. I'm not going to read through this, but what I want to point out is the opportunity for breakthrough efficiency gain. As we move through the chain here that the design/bid/build model is able to transition to a lean type approach, now known as IPD. That was a GM series, which was a pre-BIM and IPD, before they were acronyms.

But the opportunity for breakthrough gains is significant when we move beyond the stick-build mentality. This is key, and how do you actually pull away from the stick-built mentality and then start using the virtual build before construction. On many of these projects there was increased off-site fabrication, preassembly/modularization, and just-in-time delivery/installation.

I know on one of the projects, we have Cramer sitting here. Cramer did 100 percent of the sheet metal off-site prefab, preassembly, just-in-time delivery/installation on one of the jobs. I borrowed a couple quick images, and again, just talked about the company's outreach at the time. This is from a GM presentation from about 2006 at CII. The presentation was one of many, but



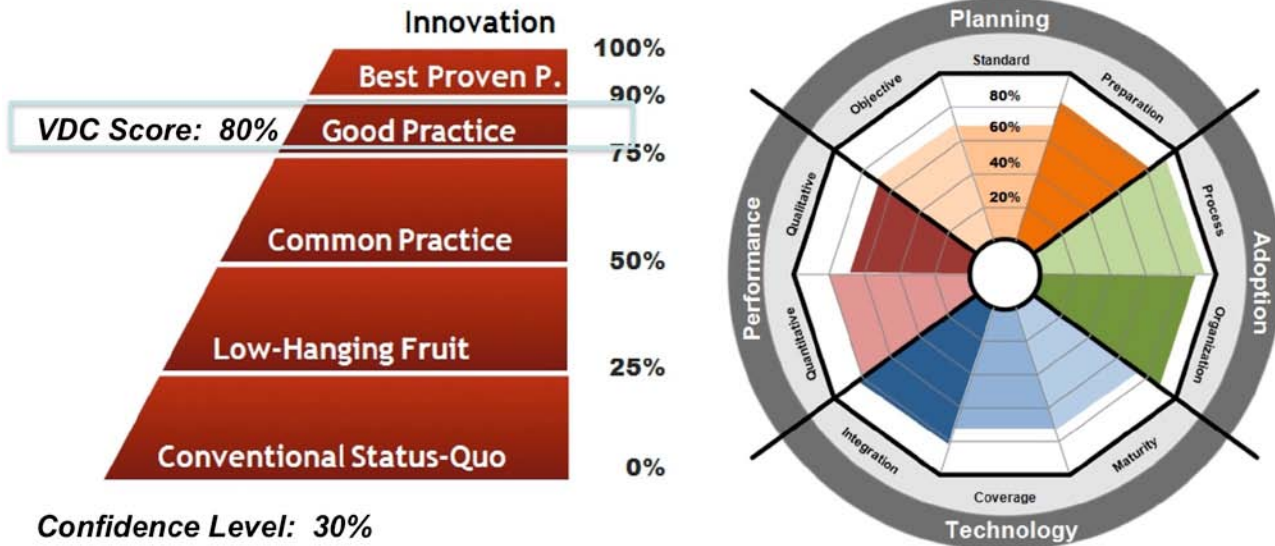


Figure 27: Results: GSA Outreach—Stanford VDC/BIM Scorecard (used with permission)

the upper bullet here was what I wanted to share with you: GM challenging their counterparts very actively involved with how to improve the industry, much like we’re talking about today.

“GSA Outreach” is another kind of metric. This is from a webinar just last Friday that the GSA shared, and I want to point your attention to this lower bullet. GSA is starting to look at how they might adopt an IPD-type delivery system within federal acquisition regulations, and that is a huge step because it is a real milestone as far as strength in terms of creating delivery systems and the fact that they’re looking at this and sharing it publicly.

Something else that was shared by the GSA is a little more holistic in the sense of metrics, but Stanford has a VDC scorecard. They are now looking at projects in terms of evaluating how those projects adopt VDC principles in terms of design, delivery, and results. And it talks about the sliding scale here from the conventional status quo, right up through the proven best practices (Fig. 27, left diagram). This particular project shows 80 percent. There’s essentially four criteria they are using and there’s several subcriteria. This is actually presented in a different fashion, but is the same thing (Fig. 27, right). Four criteria, several subcriteria, that they’re evaluating projects with.

GSA is also adopting a similar methodology for upcoming projects. So it’s not just a university or two that’s looking at how you measure this, but now you have the General Services Administration that’s going to be adopting a scoring methodology for rating how projects adopt a VDC approach. The reason the 80 percent is significant is because at

the top of the 22 projects evaluated to date, the top of that list is the Sutter Castro Valley project. The other aspect of this chart is making a list of these projects and looking at the asterisks, those are GSA projects, and they say GSA is in the process of adopting a similar scoring methodology.

Here we have the virtual build, and this is just an animation again (Figs. 23–24) It ends up looking like the poster on the wall, but if you can convert to a virtual build that has also gone through fabrication and construction, it is a real key to achieving significant downstream manufacturing like efficiency gains on capital projects. Virtual build is the same mandate GM started on their series together with a build to the model mandate that Digby and Sutter have applied to their Castro Valley project.

To view the report on this presentation in its entirety, please see Appendix M at www.esdinstitute.net.

...if you can convert to a virtual build ...it is a real key to achieving significant downstream manufacturing...

Enlightened Project Delivery: Strategies for Smart Design & Construction Management (or How to Make Sure That You Design What's Wanted and Then Build What's Designed, on Time and on Budget)

Digby Christian

Senior Project Manager on the Sutter Health Care Castro Valley Project

Digby Christian is a Senior Project Manager for Sutter Health of California. He is currently managing a project to design and build a replacement hospital at Sutter Medical Center in Castro Valley. He handles all phases of design and construction of healthcare facilities, from business plan validation and initial concept through design, entitlements, permitting, construction, and move-in and initial operation. With the Castro Valley project, Mr. Christian has been an integral part of changing the approach to risk, contracts, work planning, process flows, teaming, and many other things in order to create an overall delivery model that supports a successful outcome. Outside of the project, he is actively involved with the Healthcare BIM Consortium, which is an owners group, to bring best practice thinking to the industry as a whole.

HIGHLIGHTS:

- Very clear goals at the beginning of a project drive a very clear space program inside the building; this supports a clean design, which supports a stable construction effort, which leads to success
- Collective ownership of risk and opportunity ensures that everyone has a stake in decisions
- Committing to build the model eliminates large amounts of waste
- A 24-hours-a-day, 7-days-a-week collaborative environment expedites decisions
- Budget should be a key parameter of design, and design should be done for fabrication
- These methods have led to an 83 percent reduction in uncertainty

just wanted to recap: how many owners are there in here? Oh, that's great. Excellent. Architects and engineers? And building trades? That's good. Often you get to these things and you find there are no owners in the room, and you go, oh, well, this will be an interesting bunch.

I return to the point that Bob [Mauck] was making. This approach needs owners to be fully engaged to make it work, so I'm just quickly going to go through a bit of the outline on the project, the challenge, the guiding philosophy that's set up right now, and then how to manage the project. I will also discuss the strategies we used on this project, the results, and then on to the dispensing of the Q&A today.

The challenge is in this project: a 130-bed hospital, seven stories. We signed a single contract with a budget of \$225 million for the design and construction—it's the building on the left there. The building on the right is being built at the same time, but it's not part of what I'm talking about today (Fig. 28)

Other discrete challenges to the project included a brand-new contract model, which we'll talk about briefly. We wanted to have a new clinical care model inside the buildings, so there was no preconceived notion about how to lay out the functions. We had to finish the project 30 percent faster. We had five years to get this done instead of seven, which is atypical for this size of project in California. There was an absolute cap on funding because we had capital constraint markets in regard to how many years you have to depreciate a project over; the bond market can only carry so many bonds.

Sutter had some poor experiences on other large projects, because what you're trying to do with these big projects is not deliver them 5 percent cheaper, not to go 30 percent over, and not to deliver them six months earlier, but not to deliver them two years late, which is a real risk. We also need to LEED Silver certify the building. It's a very constrained site, immediately adjacent to residents, and you have to keep the existing hospital open. And it's in California, so it's a good seismic zone; there's more concrete under the building than there is in the building, and that's just because of where it's located. We're just about 30 miles to the east of San Francisco, and we're sitting on a quarter mile from the South Hayward Fault, which is the fault most likely to fail within the next 30 years. So this building, because they're typically 30 to 50 years old, will clearly experience a major earthquake.

The guiding philosophy (Fig. 29) is basically this: Sutter is attempting to establish clear goals for the project so that there's a clear understanding of why



Figure 28: Sutter Castro Valley Facility

we're building the building. That helps drive a very clear space program inside the building, which would support a very clean design, a stable construction effort, and lead to success. And like all great ideas, it's just a great idea. What we try to do is actually execute along these lines. The strategies I'm going to talk about start after the service space program, and it's a whole other story about how Sutter validates and establishes its goals on projects, which is another topic of discussion.

There have been certain strategies over the last three or four years of work regarding how you might go forward to the next project. We solved several hundred individual problems, and collectively they coalesced into different strategies after the fact, some of them a little bit ahead of the fact.

Saying "Collectively own the risk and opportunity" is probably the most radical departure (Fig. 30). We have a single contract under here and Sutter signed it and then ten other companies signed it, and they're all putting 100 percent of their profit at risk. If the project fails, they fail; if the project succeeds, they succeed. So what Sutter

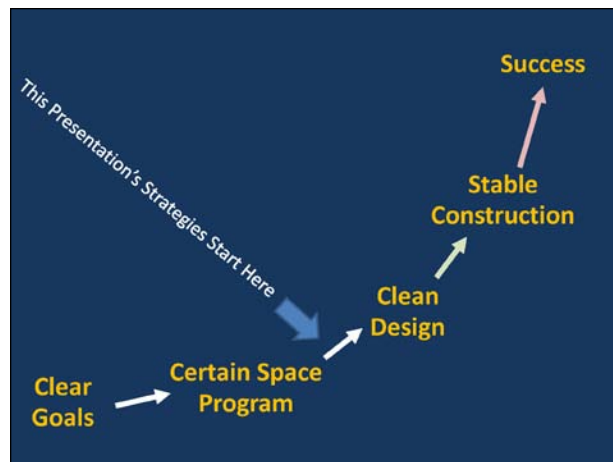


Figure 29: Philosophy

say is, should the project go catastrophically wrong, once your profits have been eaten up, Sutter will reimburse you for your actual cost of work. The idea is we won't put any companies out of business, but likely all the superintendents and project managers will get fired, including me.

That's essentially where we were, and Ghafari also signed the contract. One of the things we employed was have major mapping sessions of how to get work done, with the idea that it is better to work from a single plan together, rather than five or ten different plans. Everybody is able to talk through things honestly and realistically regarding what it takes to get a building like this done and to uncover all of the hidden constraints, which are usually constraints one person in the room has, but nine other people don't (Fig. 31).

One thing that came out of these initial sessions was the biggest risk on these projects: when owners change their mind. We established very early on that we're going to have a major milestone project, a project representing the pinnacle; and after that date, you can't come back.

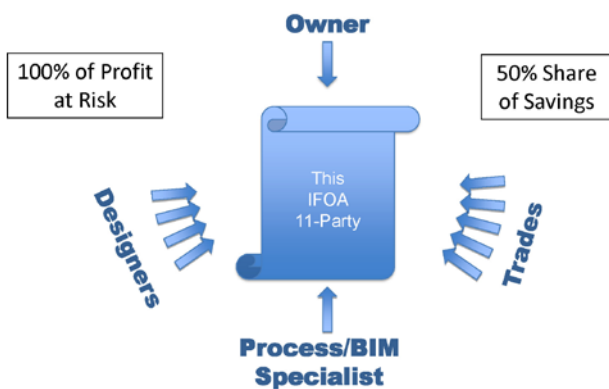


Figure 30: Collectively Own the Risk and Opportunity

...in the end we got the structural design done in eight months, not 15 months, because those 15 months were used to change decisions before the design was finalized.



Figure 31: A Single Plan

By working this way, we created an additional seven months for the owner to get to that point. Instead of going, oh, we gotta get going, circular logic discussions on who wanted what in the building and how quickly to start the design, I basically begged for six months not to start the design. And that’s what they did, and in the end we got the structural design done in eight months, not 15 months, because those 15 months were used to change decisions before the design was finalized. There are no metrics for how long or how fast you can get a structure done, so no one knows you can get it done in eight months. Everyone may say, “Yeah, but it just doesn’t feel right.” And that’s big hurdle we were able to overcome.

We also had explicit tasks, like risk and opportunity. This is one of my favorite slides (Fig. 32). When we talked about door frames and hardware, we pointed out that once you get up about 200 doors, typically everything that can go wrong will go wrong. And everyone in the room who’s involved with this knows it, but they don’t have the opportunity to change it. The conversation becomes,

We established 24/7 collaborative environment and we leased space that was always available for the whole team.

“Well, what would you do if you didn’t want any of those to happen on any door in the building,” and we came up with a process to stabilize that.

There are all commanders in lunacy in this whole project (Fig. 32). You’re almost guaranteed failure, and you have to talk to all the people who are involved in the very complex supply chain, from the owner to the architect to the engineer to the air balancing, fire alarms, power, data, IT. Doors are incredibly complex. They really are, but you only find out that they are if you talk to the right people at the right time, this isn’t conceptual design. This is construction command.

We established 24/7 collaborative environment and we leased space that was always available for the whole team. It was a co-location resource so anybody who had to meet, could meet. This is in the design phase before we had permission to be on the site. We leased the space and we put everybody who was on the project in there. We had the trades engaged and the designs engaged and the owner engaged all at the same time in this one room. And then we had small boards, and we had these conversations regarding the model about solving problems.

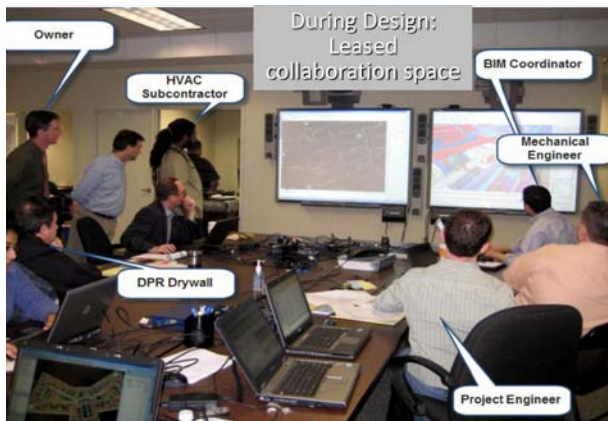


Figure 32: Collaborative Environment



Figure 33: The Big Room

This is the big room in a 7,000-ft² trailer, and it has partitions that are about 3 ft high, so you can see the whole room from any part of the room (Fig. 33). There is a lot of office space so all involved parties are able to co-locate in one area, and that very much helps. Things that designers can agree are a simple problem actually can be a very complex if you don't have the right trade partners in the room with you to explain. The designers can also give feedback to the trade partners from an engineering point of view about why a quaint solution may work.

When you see that happening on a project, you know they just figured out something else is very complicated. So on the left is the mechanical engineer, plumbing engineer. There's Randy, who's the fire protection. We had the design/build contractor; plumbing engineer; the estimator; electrical. That's the range of people up at the top there. We used ProjectWise from Bentley, which is live data sharing. I won't say I always use ProjectWise, but I will always use something that does what ProjectWise does on a project. It's quite a brilliant solution to a very complex problem. All of the files are live: you check them in, you check them out. It's sort of inherent version control, which is a nightmare on anything that gets slightly complicated.

Next is "Design the Design Process." What we found is everyone individually knows how they design a hospital, but no team knows collectively how they do it. We got together and had conversations about the big picture: the doors go before ceilings and before floor plans, what is a floor plan, et cetera. We tried to figure out the big picture just on a white board during three hours of ten people tracking, and then we actually captured it in the software because it's a complex project (Figs. 34–35).

We used "Strategic Project Solutions—Project Manager," which created the platform for us, and because we needed a vision of the space, could capture it in the software and create a work plan. There is obligation to follow because it generates the work plan, and you have to say, "Yeah, I'm going to do it. No, I'm not." Then we print everything out and export that into a program called Y-Graph and plot it on the wall, and there's the plan. It's a very great visual way that enabled us to meet 19 deadlines by date, and only one to miss by two weeks, and that one was because the state was having resource issues. And that's really hard to do.

To view the report on this presentation in its entirety, please see Appendix N at www.esdinstitute.net.



Figure 34: Design the Design Process

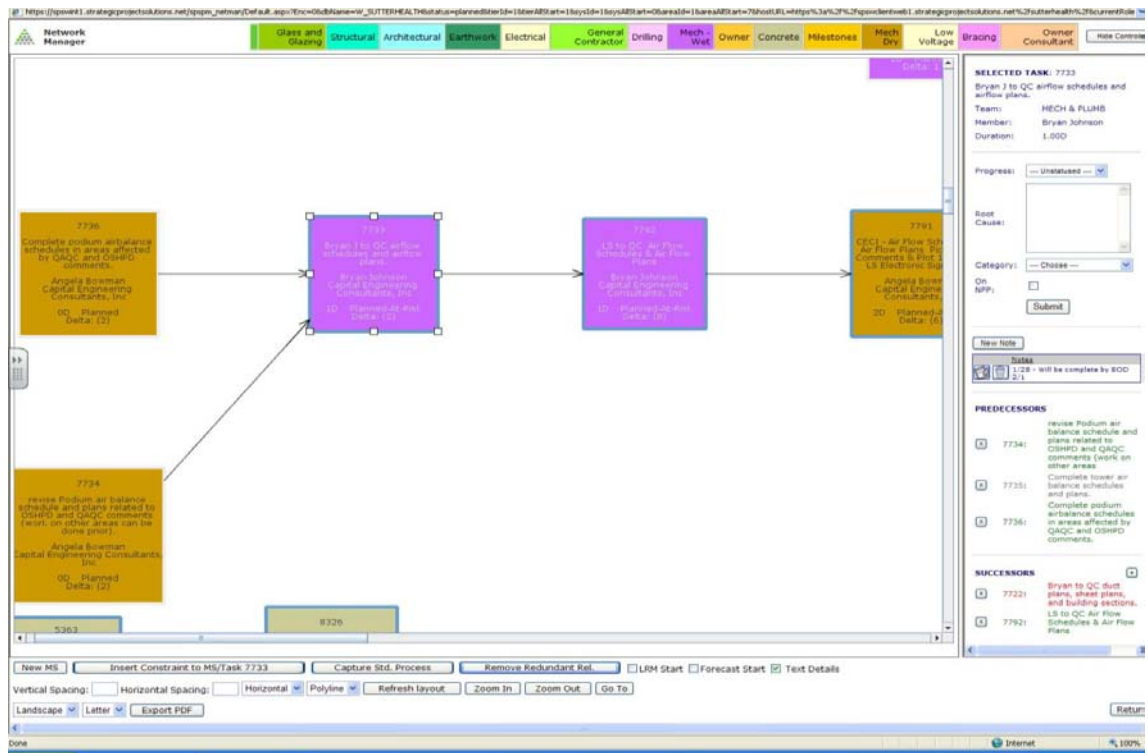


Figure 35: Design Process Captured in Software

Construction Productivity: An Energy Utility Owner's Perspective

William Terrasi

Director of Enterprise Project Management, Construction and Engineering Major Enterprise Projects, DTE Energy

William Terrasi is the Director of Enterprise Project Management for the major enterprise projects organization at DTE Energy. He is responsible for over \$2 billion in capital construction projects in Detroit Edison's power plants. Mr. Terrasi currently has projects in air quality control retrofits to plants, wind and solar power projects, numerous facilities upgrades, automated metering intelligence, and smart currents upgrades. In addition to working in partnership with Consumer's Energy on a major upgrade to the Ludington Pumped Storage Facility, he is involved in the preparation of a combined operating license application for a potential new nuclear plant designated as Fermi 3. He is a founding member and current chairman of the Michigan Owners Construction Alliance (MOCA) and a long-time friend and partner with the organized building trades labor force.

HIGHLIGHTS:

- Japan has done in nuclear power production what it has done with autos
- Much of the efficiency in modular construction lies in comprehensive testing and certification of componentry
- Modularization benefits cannot be realized without fundamental industry change
- The 10 to 12 percent perceived Michigan labor rate premium does not affect the overall cost premium
- Trust needs to be established in the industry
- Members of the workforce need to be appreciated and recognized as relevant

Ok. Nuclear power renaissance. We all know that the last nuclear power plant was built in the '70s, and we all know there's been a reemergence in the last seven or eight years, of interest anyway, with numerous applications across the country, as well as with the Japan tsunami.

The necessary time frame to do installations before was around nine years, with the longest at 23 years. And from the early '70s to the late '80s, we can see how the average duration of the nuclear installation or the complete construction cycle of completion actually lessened. That's not the total

time to apply for the application, do the regulatory things, or do the engineering. That's just the construction site. And the reason that increased over those years is regulations and increasing engineering requirements, which leads to slowdowns in construction, particularly after Three Mile Island.

Japan and others do not slow down and, just like what they did with the autos, they did it in nuclear power application. They're building in 36–40 months now. It took them a while to get there, but now it's the standard construction cycle, and the currently planned cycle for units in the United States for the first concrete to fuel load is 39–43 months.

In 2004, what the Department of Energy started looking at was the kind of advanced technology that's going to be required to move the nuclear industry forward in a more cost-effective manner. Thirteen technologies were looked at. Twelve were determined to be viable candidates, able to contribute to productivity. You see what they are there (Fig. 36). If any of those interest you, there is a detailed report from the DOE that's going to be made available to anybody in this room, and it gives some of its written course conducted by NPR. We got some great info when we did this. The three at the bottom, however, were determined to be more developed. So while we talk a lot about modularization and the advancement of information management and be able to come to the determination, they still need a lot of development. We're still pre-novice in these areas. Some of these talks you heard earlier are more advanced. We're not really advanced.

Modularization and prefabrication have the most potential in the eyes of the DOE and those who have helped them study it so we can improve in the construction project. Parallel construction came out with their issue of open-top construction again. It has a great potential, and the industry is now advancing to larger assemblies and using methods that have been employed by the U.S. Navy and of course overseas. The General Dynamics Electric Boat facility, for instance, models the Navy experience here.

The first Virginia-class submarine was built with 18 million worker hours, the second for 11 million worker hours, and the target for the 30th is 8. Much of the efficiency in modular construction lies in doing comprehensive testing and certification of the components. Every industry that has done modularization of process-type modules obviously has to do some testing at a facility. Particularly in nuclear power, there are very few QA1 requirements, and this is going to be the major stumbling block for being able to take full advantage of modularization and assembly off-site in the nuclear environment.

DOE Nuclear Power 2010 Initiative Began Addressing Construction Cycle Time in 2003



- MPR Associates, Inc. conducted an evaluation of thirteen **advanced construction technologies** in 2004, that could potentially decrease the construction time of new domestic nuclear plants
- Twelve of these technologies would benefit construction schedules; and the three with most potential for impact need more development:
 - Steel-Plate Reinforced Concrete Structures
 - Concrete Composition Technologies
 - High Deposition Rate Welding
 - Robotic Welding
 - 3D Modeling
 - Positioning Applications in Construction (GPS and Laser Scanning)
 - Open-Top Installation
 - Pipe Bends vs Welded Elbows
 - Precision Blasting/Rock Removal
 - **Cable Pulling, Termination and Splices**
 - **Advanced Information Management and Control**
 - **Prefabrication , Preassembly and Modularization** (Most potential for impact)

US Department of Energy, "Application of Advanced Construction Technologies to New Nuclear Power Plants", MPR-2610, Rev. 2, September 24, 2004

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Figure 36: Exploration of Advanced Construction Technologies

Modular Nuclear Plant Construction: Why the U.S. Navy Model?



The Newport News shipyard is increasing modularization in construction of successive Nimitz class aircraft carriers over the last thirty years

Currently the shipyard assembles 100-ton modules into 300-600 ton "super lifts"



The George H. W. Bush's island is the 162nd and final super lift in the ship's construction schedule.

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Figure 37: The Final Superlift on the George H. W. Bush Island

I thought it was interesting that the 1-3-8 rule that the Electric Board has found and cited in numerous reports is probably very similar to our studies or to any of our applications, as well.

For every activity taking an hour at the factory bench, if you want to call it that, it would take three hours on the module—virtually the same activity—and eight hours on the ship. And they have a lot of case history studies that have proven that. It hasn't really been done in the nuclear industry application on a consistent basis in terms of measuring the benefit, but I'm sure it would expect something similar.

Why the U.S. Navy model (Fig. 37)? Well, you can see a pretty cool picture here of George H.W. Bush Island. It was 162nd and final super lift in the ship's construction schedule. And our Nimitz class aircraft carriers over the last 30 years, they've been getting more and more and more modular in design and construction. Currently the shipyard assembles 100-ton modules into 300 to 600 metric ton super modules for the super lifts. Of course, that's on dry dock, and you can see by that picture and this one of the Ronald Reagan that we don't all have the luxury of that type of craneage, but it is an indicator of what can be done when we plan ahead, and the super cranes, as we know them, have evolved tremen-

dously over the last couple decades, even in the nuclear application.

On pressure hull closure, the original Sea Wolf design, which you probably remember, was only about 58 percent completed at that closure, and now they're up to 85 percent for the Virginia class. The New Hampshire was the first ship to be assembled from four modules, and typically it's ten and even more than that now in the Virginia class. They produce construction the same as they did before from more than 84–60 months for that class of sub. They employ IPPD.

So what about nuclear power plant construction? GE and Hitachi have reported that since 1990, their construction time has been reduced by 20 percent and worker hours by 40 percent. And in 1985, the plants were built with about 18 modules, and now it's tenfold that, ranging anywhere from 5–650 metric tons. Westinghouse, which builds the AP1000 PWR plant design, says that the 36-month schedule being achieved in Japan isn't really achievable here, and it's largely due to modular construction, with the largest one being 770 metric tons, which comes with rooms already piped, wired, and painted.

This is just a graphic (Fig. 38) that shows parallel activity performance, the way a lot of site preparation activities concurrent with off-site fabrication, and

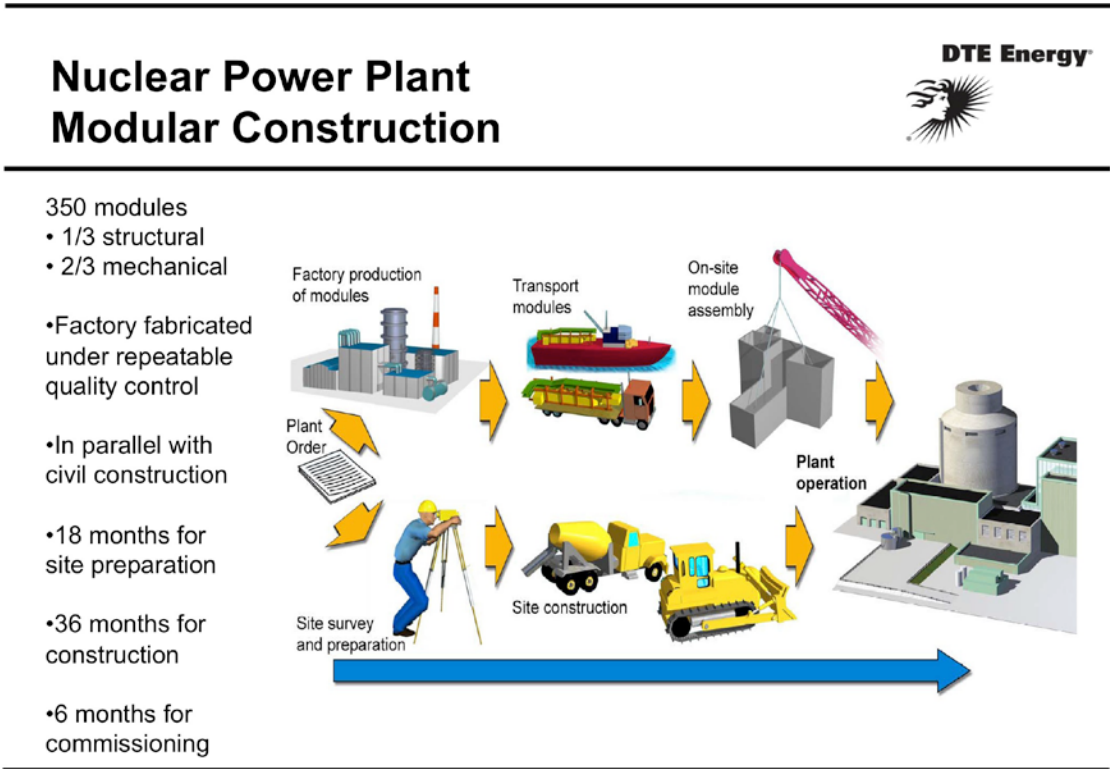


Figure 38: Parallel Activity Performance



Implications of Modularization in Nuclear Power Plant Construction

- Modularization does not guarantee less cost or shorter schedules without *proper detailed planning* and *early, increased engineering* – a complete analysis must be performed at the conceptual stage, of:
 - *Site evaluation – available space, congestion*
 - *Site access – barge access provides optimal situation*
 - *Site transportation – pathway, paved roads, substrate*
 - *Module lifting – super cranes, availability, location*
 - *Location / availability of module fabrication facilities*
 - *Labor availability / cost of labor*
 - *“Build it clean, Build it tight”*
 - *Total team commitment to modularization and rapid issue resolution*
 - *Commissioning Team up-front involvement in specification of factory tests*
 - *Testing and certification of components at the fabrication and module facilities*
 - *Design for PPMOF,*
 - *Commitment to necessary earlier cash flow*

Figure 39: Implications of Modularization in Nuclear Power Plant Construction

they come together for plant construction. I'll show you some nice pictures of that in a minute. It typically looks at an 18-month site prep on a 36–43-month construction schedule itself, and six months for commissioning. The implications of modularization in nuclear power do not guarantee there's going to be less cost. We tried to employ modularization in a standard cost process of standard process of releasing projects and cash flow. It won't work, and there's a fundamental change that is needed in order to realize the full benefits of modularization.

I won't go through all of those sub-bullets (Fig. 39) because it's obvious what needs to be done, what needs to be considered for using the benefits of modularization, but the two at the bottom we were designing for PPMOF design, fabrication, pre-assembly on-site. Our universities don't teach our degreed engineers how to design in modules. They teach them how to design and knock them out, but I think academia needs to come on board as well in teaching this new method for construction design. And a commitment to necessary earlier cash flow by the owners is probably the most critical element. Cash is king, and when we're trying to defer the capital costs as long as possible for obvious reasons, that has a short-term benefit and a long-term cost. More implications of modularization in a nuclear plant are that the design must be complete and material

on-site before fabrication begins. A sufficient supply chain needs to be developed at least six months prior to initial work.

We've heard a lot about work packages already, and at least two of the facilities have been using this a lot. That would be Shaw's facility down in the south and Cianbro in the east. Both have printed a report that, again, if you're interested in getting, I can help you get your hands on that. They give their perspective on what is necessary in order to achieve the full benefits of prefabrication in the field.

Full QA and QC involvement is required from the time the work packages are developed through final certification. Work packages try to target information. That's the love of the detail that goes on when you take that times the massive installation we're doing, we're going to create a four-year period, and you can imagine that's work package planning, as well. It's more applicable in nuclear than it is perhaps anywhere else. I think it's still a necessary element for all of us to consider. Some processes should be used for non-safety as well as safety-related equipment. Again, the QA requirements, the safety-regulated equipment in a nuclear power plant, are sensitive and perhaps the biggest obstacle to begin to achieve the full benefits of work package organization. And some of our AE is very active in that, but you can't fall back and expect to do a half-baked job on the non-safety systems.



Figure 40: Shimane Unit 3 Nuclear—Japan: December 2007



Figure 42: Shimane Unit 3 Nuclear—Japan: September 2008



Figure 41: Shimane Unit 3 Nuclear—Japan: February 2008



Figure 43: Shimane Unit 3 Nuclear—Japan: September 2009

Here's a cool picture, as well. Quickly, this is about a 500-ton super lift on a Haiyang unit. And more of that unit. Okiluto and Sanmem are containment, more typical and more standard super lifts. And Shimane unit in Japan that some of our people have benchmarked (Fig. 40). I'll show a series of pictures to how that progressed over time. Note the dates in the upper right-hand corner. And, of course, this has been preceded again by about 18 months of site preparation and probably about nine months of the ground mat and foundations being installed (Figs. 41–44)

We're getting ready to lay some equipment pads just above the ground mat in December 2007 and February 2008, and just a few months later we're starting to put in containment modules. The HCCU room installation comes right on the heels of that. Within another six months, by September 2008, they're coming out of the ground everywhere on this critical path and there's plenty of activity going on in the parallel path. Another picture, the same time frame, fall 2008. And then by March 2009, about six months later, they're doing the monster lift, which is the upper drywell module, and that weighs over 700 tons. Shortly after that, reactor pressure



Figure 44: Shimane Unit 3 Nuclear—Japan: April 2010

vessel lift happens first, and by September 2009, you can see the buildings are well on their way, they're continuing in a parallel build. And by April 2010, or nearly the end of the three-year cycle, you can see that the buildings are nearly complete. The reactor building, the one in the middle there, is still the critical path.

To view the report on this presentation in its entirety, please see Appendix O at www.esdinstitute.net.

Day 2: Blended Panel Discussion

Day 2 began with workgroup report-outs from the breakouts of the previous day. To react to the ideas coming from the groups, a panel was formed made up of representatives from the fields of owners, subcontracting, engineering, design, and labor. The panel was made up of several speakers from the previous day, including:

- **Digby Christian**, *Senior Project Manager on the Sutter Health Care Castro Valley Project*
- **Bob Mauck, AIA, PE**, *Vice President of Virtual Design and Construction, Ghafari Associates, LLC*
- **Bob Pleasure**, *Attorney and Director of Education, Building and Construction Trades Department, AFL-CIO*
- **Bill Terrasi**, *Director of Enterprise Project Management, Construction and Engineering Major Enterprise Projects, DTE Energy*

Additional panelists who did not speak on Day 1 were:

- **Farid Berry, PE**, *Vice President and Project Director, Sargent & Lundy*—Farid Berry holds both a bachelor's and master's degree in nuclear engineering from the University of Michigan. He is a Vice President and Project Director in Nuclear Power Technologies group of Sargent & Lundy.
- **Matt Cramer**, *President, Dee Cramer Inc.*—Mr. Cramer is the President of Dee Cramer Inc., a 74-year-old sheet metal/HVAC contractor in Holly, Mich. He holds a BBA in accounting from

the University of Notre Dame. He is SMACNA's appointed representative on the Board of Directors of the building SMART Alliance, a subsidiary of the National Institute of Building Sciences in Washington, D.C. He also serves as a board member for National SMACNA, as well as its local chapter. He is also a Trustee on the Sheet Metal Workers Union Local #7 Pension and Health & Welfare Funds and is very active in his community through many organizations, including the Regional Leadership Council of the Genesee Regional Chamber of Commerce and Big Brothers and Big Sisters of Greater Flint.

- **Jack Hallman**, *former Director of Global Capital Projects at in Worldwide Facilities at General Motors*—Jack Hallman recently retired from a 40-year career at General Motors, where he served as Director of Global Capital Projects. Mr. Hallman began and worked for many years in GM's manufacturing area, spending the last decade in construction management of GM manufacturing facilities. He is considered a pioneer driver in lean construction techniques at GM, as well as a leader in moving toward the implementation of BIM design-build projects at the company. He holds a BS in business administration along with an MBA, both from the University of Detroit.



The following charts represent the key points raised during the morning report-outs, and comments by the panel as they were presented.

CULTURE WORKGROUP REPORT-OUT KEY IDEAS:

Considerations between open and closed culture (inclusivity)	Water is important and Michigan can capitalize	Trust building
Risk/rewards sharing	Evaluation of how open culture should be	Common success and failure
Solutions, not blame	Owner buy-in	Codes of excellence
Project management system process		

STRATEGY WORKGROUP REPORT-OUT KEY IDEAS:

Best practices/methods	Single-voice organization	Mission of economic development
A link to MEDC and other organizations of subject matter experts	Facilitators	Where did previous groups go wrong?
Incentives		

**Note: All of these surround the idea of an institute or collaborative body to re-create, rejuvenate, reestablish the labor/owner/contractor/AE organization that will speak with a single voice for Michigan.*

MR. TERRASI: There wasn't anybody from our labor sector in that discussion. I guess I'd like to hear, although they weren't, what they feel it is.

AUDIENCE MEMBER: Pat, are you in a position to make a comment?

MR. DEVLIN: Thank God my coffee just kicked in. I guess I'm just caught off guard, and it's a very important situation we're discussing here, but I don't know what this is going to do for productivity. So, with that said, no, I think the Great Lakes Construction Alliance, and all the groups that were in the room at one time, was a very, very powerful group, powerful decision-makers, and I don't know if we ever hit on what transpired over the years with that group, but we didn't. It eventually evolved into not having the decision-makers at the table. So I guess that would be a major challenge; are we ever going to be able to put the decision-makers back at the table. We had at one time, and I think it was a unique experience. I don't know if we can assemble that again.



MR. WEBB: I just would add to this, I think that for this, if folks who are in labor and want to travel a couple over to give reality checks or to listen, it might be valuable. Let's hear from the next group, which is technology.

TECHNOLOGY WORKGROUP REPORT OUT KEY IDEAS:

Integrated design	Technology as the key to productivity (BIM)	New Method: Design/Build/Costs
"Pure Michigan"	Demonstration to owners	Life-cycle costs
Accurate, accessible data	How do we sell this?	Pilot owner's program: publishing strengths, failures
Process integrators/facilitators	Align educators/construction code of ethics	

MR. HALLMAN: When you say you want the owners to pilot something, what is that something? What's the technology?

AUDIENCE MEMBER: Well, we were talking about what'll probably finish this and talked through that in our workshop follow-up this morning. But we started off on BIM and speaking mostly to the technology, and then we got into a discussion of integrated design and the concept of the programs that we were

looking at yesterday with Sutter Health, and basically kind of combining those using the technologies, the integrated design process or the methodology, as we started the state of establishing it in that way. Rather than basically focus on design/bid/build program, we could have some owners who would engage and either be in fully integrated design or to some level of that, you know, which incorporated a lot of these aspects of it, so it could be a step and a phasing, you know, as a next step.

LEGAL WORKGROUP REPORT-OUT KEY IDEAS:

Model construction contract	Common terms and conditions	Equitable: shared risk and reward
Collective risk management	Industry action group	What is a design deliverable?
Agree on total design	Labor/management operating agreement (long-term liabilities)	Metrics for construction productivity

MR. BERRY: Let me start by saying we can have the best workforce in the State of Michigan. We don't have jobs, we can't do anything. That's the first time I have been to this conference or symposium, and I believe that's what we're focusing on. Quickly, to go through the four topics here, culture, we all believe in culture, we all have processes in place, and we train our people. I think we need to focus more on the State of Michigan from an environmentally friendly atmosphere and culture, and that's what we need to market in my business, in my opinion.

We need to focus on the lead certification on how we are an environmentally friendly state and try to focus on that to bring in more domestic and global business into Michigan. On strategy, I like what I saw up there. I'm a strong believer in tax incentives. You have to have state intervention. I attended a conference in South Carolina, and the whole conference was about how South Carolina was energy-friendly.

We want to bring business here, and that's what we need to focus on. We need to figure out what is our strength, what we can sell, what are our resources. We talk about the waterways. We have other resources. I was privileged to attend one of the best schools in the world, the University of Michigan, and you have a lot of resources here that you can use to help with the technology, with the strategy, working with the universities, Michigan State, and other schools. We have all the resources we need to build on rather than just focus on one thing or another.

As far as technology is concerned, I'm not sure I followed what was said other than we need to put the process in place and some pilot programs. I think we all have these, we all optimize. We look at our systems, our processes, we optimize them, we study them, and we build on them. I think what we need to do here in technology is understand what we're trying to do in Michigan. We have a lot of companies here that have a lot of expertise and export that

expertise overseas and throughout the U.S. We need to build on that, and I think the first thing I would do is identify that technology and build on it.

I don't see anywhere where we talk about state intervention, about supply chain process. These are strong things that you have to have to bring in more business. And training, I believe we covered training for all workforces, for all staff. We need to build new plants based on a new technology, use the latest school that's out there. This is how the Japanese were able to build a nuclear power plant in 35 months. They're using the latest technology, and we can do that and we're working on that.

I work on a plant right now. We are building a nuclear power plant overseas, and we have what we call construction command center, and we are trying to bring that to the United States. And basically I can ship a reactor vessel from Japan Steel to United States or to anywhere in Europe. We have a chip on that vessel. We're tracking it in our construction command center. All the time we know exactly when it's going to arrive at the site, at the facility. We track work in the field. We monitor everything. We work with everyone with the construction force. We're trying to use all the latest tools that are out to help with that. And I think we need to do that and that's what we need to focus on.

As far as legal, I mean it's great if we can get a standard contract in place. Many people tried that and never succeeded. And are there any lawyers in the house? Then, no comments.

MR. WEBB: While the owners are up here, one thing I never heard, or did anybody say it? Did anybody say that the cost of labor was part of the problem? Would you all agree that the cost of labor is pretty much irrelevant to what we're dealing with on productivity?

MR. BERRY: The two are parts of the cost equation, so, well, labor rates and productivity equal cost of labor.

MR. WEBB: Yeah, yeah. For Michigan would you say that where we're at in that equation is a barrier to construction in Michigan, or not?

MR. TERRASI: Well, I think it is to a lot of people outside the area who don't know our labor force, that all they focus on is black and white, which is the labor rates, because we don't have anything to show on productivity that is perception. Many of us believe we have the most skilled workforce, and as I said in my presentation, I said a 10 percent labor rate premium does not equate to a 10 percent labor

cost premium. We don't believe that. A lot of people don't believe that and a lot of people do because there isn't anything in black and white to prove otherwise. So we don't, and we have talked about this many, many times with the MCIP groups and, you know, other groups, and say, well, how do we market ourselves better, how do we show demonstration projects, how do we create a pilot project? How do we demonstrate the capabilities when all people have, let's say detractors, even though detractors is the wrong word, but people with other viewpoints on the cost of construction in Michigan and all they do is show the labor rate figures in your face? There's no viable comeback that we have developed other than personal opinion, personal experience.

MR. PLEASURE: Well, speaking as an owner, the AFL-CIO owns its own building and we're retrofitting it now, and we don't think that labor cost is an issue. Now, I wanted to focus on a number of repeated comments about risk sharing and modularization. We think that when we begin a process, the earlier the process includes labor, the better, well before pre-job conferences, so that this kind of a meeting is extremely helpful, and there are very few jurisdictions in which there is an entity that brings the owners and labor together.

We're frequently interpreted by other people. As Bill just said, labor rates are frequently interpreted by other people, and somebody says it's high. High in what terms? Or say it's low, low in what terms? What's most important is that at a very early stage, we have fairly transparent conversations about what it is that we want and what information they can share with us about what it is that they need, and one perfect example is modularization.

We sat down with the nuclear industry in the early stage, and they said we want you to understand that modularization is a very important part of the global economy today and it's a very important part of the nuclear industry. So we agreed to put this language in our agreement that parties recognize the complexity and scope of global procurement, they also recognize that the design of the newest generation of nuclear plants is dependent upon modular construction techniques, prefabrication and modular construction issues will be addressed in an addendum covering each individual project and job site covered by this agreement, which embodies a general agreement on principles. Also, that we understand as a matter of principal that this is a change in the environment, in the construction process, and we are ready to discuss it project by project so we can improve productivity in each of these cases. So we've got the first new nuke in four years or so in Georgia right now, and modules

are coming onto the site, they're being welded by high-skilled welders. One of the issues we have is that we need to get very, very early warning as to what the labor needs are so there are no crises to face.

The bottom line is—here's the notion that I'm trying to share—that productivity is in our interest quite as much as every other stakeholder in the construction industry, and the earlier we get information about what it is the owner requires, we can factor it into our bargaining and our planning in such a way we think we can meet the requirements the owner has in a way that maintains high standards in the construction industry for workers, as well as for owners and contractors.

MR. HALLMAN: I've got to apologize for two things before I get started; one, my Myers-Briggs type is an ISTJ, so I'm very quiet and reserved, and I'm sure some people in the audience will agree with that.

AUDIENCE MEMBER: Right.

MR. HALLMAN: Right, yeah. Second thing, I haven't been to one of these conferences in a couple years, so I've got two years of pent-up emotions, I guess, to let out. So fasten your seatbelts and let's go.

MR. WEBB: Start writing it down, guys.

MR. HALLMAN: And I'm retired, so I don't represent any company. I'll say that right up front. I spent a lot of time with General Motors, but I'm not speaking for General Motors. I'm speaking from a personal standpoint. Owners basically are looking for projects with the highest possible safety, the highest possible quality, the lowest possible price, and as fast as humanly possible. Simple. Just go do it. The things we're talking about today are some of the enablers that get that done. You've got to bring new technology into how we do business. I spent 30 years in manufacturing before I got into the construction end of the business.

It's interesting, lean manufacturing, you hear a lot of about it, books have been written about it and so forth. The amazing thing is we began implementing lean manufacturing techniques, and guess what happened? Automatically our safety improved, our quality went up, and obviously our costs went down, and we were doing things faster than we ever did. And we did that basically by eliminating waste out of the systems. And yesterday you saw—I used to put presentations on—I forget the number back when I did it a couple years ago, but about 60 percent of the work we do on a construction site is waste.

So, you know, we can talk about labor rates and so forth. As long as we have competitive labor rates in Michigan compared to the rest of the country, we're okay. We need to be competitive, but we've got to get the waste out. If 60 percent of things we do on a construction site is waste, it's not value added, get rid of it. Take it out of the system. I wouldn't want to help pay for it if I were an owner. You know, I heard of a lot of comments yesterday when I showed up and talked to some of my—and I'll use the term loosely—friends in the business about how GM is focused on cost. Well, if you went through what GM just did, I guess I'd be focused on cost from a number one, you know, focus probably.

Owners need to drive the system. Owners need to drive the industry to do this, but the industry's got to get up and learn how to take the waste out of the system, be it technology, be it legal issues, be it strategies. The thing you owners really have to do, I think, is establish the culture on the sites and in the business to make it happen. The culture I think is the biggest overriding factor. IDP, I guess you guys, the latest buzz word is collaboration; you know, teamwork. Whatever you want to call it, okay, people involved have to have that or you're not going to get anywhere on a site. You've got to have common goals, defined responsibilities for every entity on the site, but you've got to have the right culture, and the owners have to create that culture or at least start that culture and allow it to flourish to be successful.

We have the greatest technologies and we've got to have the best of the best. And it's continually changing, continually improving, and you guys have to stay up with that. You've got to stay at the leading edge of technology; 3D, 4D, I'm sure the last couple years, a lot more past that. You've got to look at your business, you know, from a waste standpoint—I keep going back to that—and learn how to take it out, identify it.

You know, I used to get frustrated on my job. Long lead items. When I got into the business, I got to have long lead items, got to get the air houses ordered. We got them ordered, they got delivered, and they sat there covered up for six, eight months before we ever installed them. Why? Why can't I have an air house built all the way back at the beginning of the supply chain, right through the system and delivered just in time? I don't want to have to pay for it any sooner than I need to, then its need in building, and take it off the truck and put it on the steel. Don't set it down, don't move it, don't rearrange it 16 times. Off the truck, in place. Why is that such a difficult a concept to get going?

Those are the things owners are looking for and waiting for contracts to do. If some contractors

really go out and start doing that, both AE firms and contractors and their workforce, you'd be having owners sitting at your doorstep waiting to give you business because your safety would be outstanding, your quality would be high, your costs would be low, and you'd be doing it faster than anybody else. So that's my opinion, for what it's worth, for a big guy who's been out of the business for a couple years, but that's what I think owners are looking for. I'd be looking for the same thing if I was building a house. I'd be looking for my contractor to be doing the same damn thing if I was building a new house right now or a million-square-foot plant. Those are the things we need to look for. Thanks.

MR. CHRISTIAN: This is very briefly. The only thing I can really think about is what I sort of did in terms of why do I have some kind of relationship to what needs to happen in Michigan maybe, and it's not a—before I joined the company in the early 2000s—so before I joined, I sort of wanted to announce to the construction community that I wanted to change the way it was doing business, and the reaction they got back, well, you'll need a new contract if you want to do that. I'm summarizing a very long detailed discussion, but essentially it came down to that, so Sutter came up with a new contract, and that's why we actually came up with a new contract because we were told that. You may have really good ideas, but what contract would you have us sign to allow that to happen? So in a sense what they were saying was behavior in culture is driven by the contract, especially on a project that has challenges.

Any project that's overburdened, or is too big, and you get the idea, you could write that contract on a napkin and you have nothing to worry about, but once you get a project that's challenging and financially constrained, if your contracts are wrong, behavior's going to follow the contract. So I mean all I was saying is that it might be a very difficult thing to do, but if Michigan was trying to distinguish itself from other places in the country, if it could go down the path of announcing that we will have a different contract as the default contract for construction in this state—you can always do the other ones, but the first choice would be this new kind of contract here—you would probably get people to take you deadly serious, because once we actually come back with the contract, the reaction is, oh, my God, I think they're serious, because who hires lawyers to actually create a new contract to back up the vision that they have? That's how Sutter distinguished itself in the market in the Bay Area, and then with all the goals, everyone wanted to build data centers and biotech companies. That's just the thought I had.

AUDIENCE MEMBER: In your teamwork, in your process at Sutter, how often did you reference the contract to see if you were doing things right?

MR. CHRISTIAN: At Sutter all the waste and incentive were driven out, there were two key elements to the project; your profits are at risk and you get to make more money if it's successful. And on the gains, that's a management group that runs the project, and those are the two key things. And those two things more than anything else that's in the contract drive 90 percent of the behavior in the project.

MR. WEBB: Say it one more time.

MR. CHRISTIAN: It's the fact that profits are 100 percent at risk. Right now if we come in below the target cost of the contract and if your profits are at risk on the project, you get to sit on the management group that runs the project. And that's the thing I didn't have time to get into yesterday, and it's kind of radical because all the decisions of that group are required under that group to be unanimous.

MR. WEBB: Regardless of the contract side, if it's your profits, you get to be the UN.

MR. CHRISTIAN: Yes, well, God, no. No, no.

MR. WEBB: You have veto power.

MR. CHRISTIAN: Yeah, you have a lot of influence, but essentially you have to bring everyone else along with you.

MR. MAUCK: Digby, I wanted to touch on that as well. We didn't have time yesterday, but it's not just the contract. It's a great contract and it has lean principles embedded across the team, they're deliberately breaking down the process, how do you improve flow offset and design, fabrication, construction team with the objective of that virtual build you talked about briefly yesterday, so there's a contract there? And more importantly, there's also an operating organizational collaboration, just not what's written down on the paper. That core team provides guidance to this IPD team, and I believe if you can structure it a reliable way, you can really baseline the consensus. If there are issues, there are about six levels an issue that will go through before it's outside of even the IPD structure. So maybe there's a structure under there that gives you various vehicles for resolving issues internally at the lowest common denominator.

MR. WEBB: Did you metric the waste? I don't remember in your report where you had a quote for "waste metric." This 60 percent kind of just didn't make my day. So with that, did you have something that helped on that, or did they just have profit and plenty of waste?

MR. CHRISTIAN: I don't know. I mean we did. We studied waste on the project because people wanted to make more money, so that's why we actually hired a consultant to watch how the construction build was going and how much direct work and how much other work, and that sort of thing. So if people within our team had a profit-at-risk contract, we were at in the low 70s ultimately, which is way, way higher than normal.

AUDIENCE MEMBER: That number is correct, actually worse than that because they can support a piece of that CII study that was 30 percent, and a portion of that can be eliminated as we collaborate as an industry and become creative to find out. So that's a big part, a huge opportunity for the industry to improve what we do at that level. We have a large representation, like an LCI chapter in Michigan here. We have Mindshift represented, pursuing a similar effort. So part of what I think we need to be doing and there's been a lot of discussion, how do we build a coalition? How do we unify this direction? If we have time a little bit later, I'd love to have Digby maybe share some of these things about how the team actually approached these in the models.

SUMMARY TO THIS POINT:

MR. SIER: Well, one of the things we started out with was the topic of, without jobs, there's really no need for productivity studies. So the key is to encourage and increase the number of jobs by determining and identifying the strengths we have here in Michigan. Part of that was maximizing technology to improve productivity, and finding a way for state intervention, whether it's supply chain management or developing more incentives, as well as improving the training and education, and then dealing with the metrics for a true, verifiable cost of labor rather than relying on anecdotes and personal opinion that, yes, we are the most efficient. We also need to come up with some form of metric that can be compared across different platforms. And one of the critical components was early involvement of labor to have the transparent discussion of the wants and needs of the owner, particularly with regard to modular and prefab, so that that could be integrated into or factored into the bargaining agreement.

Then, as far as the wants and desires and targets of the owner, it's for increased safety, increased quality, increased speed at a lower price, and the lean techniques tend to lean toward the increased or the improved safety, the higher quality and the greater speed. Whether or not it affected the price leads us into eliminating waste. Where 60 percent of the cost going into construction is potentially not value-added and wasted, that needs to be the focus, to try and reduce the cost of the construction, whereas the labor rates just need to be competitive and the productivity improvements will come through the lean techniques. But from the owners' perspective, the owner needs to drive that system. They need to drive the culture change to encourage best practices, to encourage the leading edge, and one of the examples was the scheduling and coordination and just-in-time deliveries.

We had the topic of the behavior and culture leading into that, derived from the contract, where there needs to be a new contract delivery model that becomes the standard approach. And it was leading to the discussion of integrated project delivery, where you have a core group or a management group that includes all of the stakeholders who have profit at risk that encourages more collaboration in a coalition.

MR. J. HARTFIELD: And I kind of just filled in, you know, while John was writing on different things, you know, and I heard the question what are we trying to bring to Michigan via technology, and another person spoke up about using our ability to monitor all phases of the project through technology. The other key piece, you know, maybe that we ask and also have to promote or talk about or benchmark is the piece that said 10 percent labor rate doesn't equal a 10 percent labor cost.

Labor, again, I had it being involved early to address and get buy-in in general on the whole project, and to help show the different pieces that need work. And I just had a list up of what owners want: safety, quality, lowest price, fastest done. I had to eliminate waste on the job. As job one, using somebody's slogan. Stay on the leading edge of technologies and the just-in-time as being one of the deliverables the owners would like. We, meaning Michigan, will have a "new way" contract, and it will distinguish Michigan and then also have an operating organizational structure.

MR. CRAMER: There's a great book out called The Five Dysfunctions of a Team, and basically those five dysfunctions are exactly all of the problems we have on our construction delivery system today. The

base level of the first main dysfunction is the absence of trust, and all of our documents pretty much are written to take trust out of everything.

And the second one is the fear of conflict. I think that's one of the things that made the Sutter Health project work well, is that you have subcontractors, and this is coming from a subcontractor, so I'm probably biased, but if you want me to get in the room and you want me to put my profit at risk and you want me to show you what my productivity is, and if I do better, I have to give that back to you. I have to be willing to have a seat at the table and I have to be willing to say, hey, we've got to do this differently because it's impacting my productivity. If you want me to put that up, I've got to be willing to say, hey, we can't do it this way because of this, this, and this. So the fear of conflict is something that I think is extremely important.

The next one is a lack of commitment, and ultimately the reason why I say that our agreements show a lack of commitment is because of the silos that we operate in and that everybody's looking out for themselves, and that's the way our contracts have been created and they've been set up. And if we're just going to operate for ourselves and I'm going to operate in my vacuum and I'm going to put my sheet metal out in front of everybody else regardless of what else comes out there, the reality is, is in the short term of me getting that first part of my job done, essentially I'm going to get buried on the back end by everybody else. And so we have to have a commitment to what we're building and the project that we're building.

The avoidance of accountability, and I can't tell you how frustrating it is for me to put a \$4- or 5-million design/bid/build price out on the street with drawings that say that these are for diagrammatical purposes only. Now, my house is on the line with my business. I personally guarantee our bank line, our bonding, everything else, and you want me to get into a \$5-million job and you want to tell me that I can't rely on those documents, and then you're going to put, with all due respect, John, you're going to put legal documents that I signed that says I literally can't rely on those, and that's fair? No.

To the owners' standpoint, it's not fair to you either. I mean you can't just have an open checkbook, but the reality is we've all got to be accountable, and that's one of the things these teams do in these trust-based agreements, these integrated agreements do is they allow us to work on this level where we're working together and that we're accountable and that we're holding each other accountable, and that I can sit in a room and I can actually ask the general contractor why in God's name his schedule is set

the way it is. We're building the building from a mechanical room out, and the schedule is from top down. Why is that? It doesn't make any sense.

I have to be willing to ask questions of other subcontractors; why are you using this, couldn't we use this, or couldn't we modify this, wouldn't it make it better for both of us, or couldn't we use the same racking system to prefabricate some of our ductwork with your mechanical pipe? So we all need to work together.

And the final one is the inattention to results and being results-focused. And I just think that, you know, the one thing I'd ask is if you're an owner in the room, read that book, take those things to heart and commit to doing something different.

What I can tell you, Jack, is, yes, the owners need to do things differently, and I can tell you with trust-based agreements, I'm very confident that the subcontractor community will come around and will be willing to work in those environments, but we've got to be willing to just say it's broke, let's do something different. That's why I applaud what Sutter has done, and we need more of these types of agreements to address some of our problems.

MR. WEBB: I want to just add on incentives. We're broke, so let's talk about what we're going to do other than fiscal incentives. We can look at all of it. And on the other one, everybody I talk to that's in state government and county government says, we want to be an export state, we want to be an export state. How are we going to do it? Construction is one of the keys. We're shipping this stuff all over the world.



Workgroup and Process Reports

Strategy Workgroup

FOCI:

- A consortium body that solves problems in the Michigan construction industry with one voice
- Marketing Michigan's strengths

INTRODUCTION

This report highlights the consensus-building process undertaken by the Strategy Workgroup, whose diverse perspectives resulted in an initial framework for a “consortium or institute” that will represent the stakeholders of Michigan’s construction industry and will speak with a single voice on its behalf. Though the entity was not fully developed or named during the symposium, its key functions were identified, and an action plan for its development and implementation was created. The workgroup participants chose to broaden the scratch question for their discussions beyond the concepts of pre-fabrication and modular build strategies and tackle the larger question of identifying the best practices and methods for creating a state-of-the-art industry. The launch point for their discussions was this question:

If you were applying new methods and processes to increase construction productivity, efficiency, and industry competitiveness, what would they look like, and how would you use them?

Through a facilitated brainstorming process, the participants delved deeper into the concepts of competitiveness, efficiency, and productivity in the construction industry, which were introduced during the informative plenary sessions. Potential actions were prioritized, and the top idea was evaluated by identifying the strengths, weaknesses, opportunities, and threats inherent in it. Following an in-depth discussion and analysis, the workgroup was ultimately able to create a framework of action steps for moving forward, as described in the RASI section below.

BRAINSTORMING

Symposium participants brainstormed the following topics and themes for consideration during the workgroup discussions. The workgroup chose to combine topics that were substantively similar. These themes emerged as the priorities for the workgroup to explore in more depth:

- First, create a consortium to comprehensively strategize and act on the Construction Michigan Advantage (not ad hoc); make a Michigan Construction Industry Institute for funded collaborative problem-solving
- Trade subs need to be willing to put profit at risk if owners are willing to deliver jobs in a new collaborative, environment
- Re-introduce and support complete front-end planning on all project endeavors; owners commit to modularization decision-making at the start of the project
- Create software integration system across disciplines
- Increase the awareness of Michigan to the nation/ companies searching to relocate

ASSESSMENT

PRIORITIZATION OF TOP IDEAS

The workgroup participants shared a perspective that the construction industry is very much in need of a single voice to bring business back to Michigan. This was reinforced by their recognition that the idea garnering the most votes during the sticky-dot process was a simple, but powerful one: to re-create a consortium of labor, owners, contractors, and other stakeholders. In reflecting upon the other brainstormed ideas, the group concluded that many were potential functions of the consortium/institute, and might be embedded in it as it was developed further.

WHO, WHAT AND HOW

Before assessing the strengths, weaknesses, opportunities, and threats inherent in the creation of a construction industry consortium/institute, the workgroup chose to define the concept a bit further. Brainstorming discussions resulted in the lists of potential stakeholders, consortium activities,

and implementation strategies (for full lists, see Appendix P). The group brainstormed a long list of potential participants that appears on the chart, and later agreed that the primary stakeholders for the group should be labor, owners, contractors (or their associations), and A/E (architectural and engineering) firms. The other groups shown on the chart would be consulted on an as-needed basis.

As a result of the dialogue about what the consortium/institute would do, and how it would be done, a tentative framework for the initiative was developed. This model puts the consortium/institute in a facilitative role; the ovals represent the major functions of the entity, including areas of expertise that it might provide (Fig. 45).

The workgroup participants were very aware that there have been previous construction industry alliances, such as the Great Lakes Construction Alliance and Michigan Construction Industry Partnership. They determined that assessing the strengths and challenges of those alliances might provide some relevant lessons learned to apply to their new model. To build upon the successes of previous alliances and avoid some of the challenges, the group discussed what worked well (and didn't work well) in those iterations:

What worked well in the previous alliances

- Staff: Full-time and dedicated
- Funded by participants
- Owner participation
- Shared purpose/commitment

What didn't work in the previous alliances

- No sustained actions on CPOD ideas/consensus
- Ad hoc attempt with no dedicated staff/time/commitments (for MCIP)
- Falling away of owner participation, possibly caused by a dispute over a vendor who was providing the database management for drug/alcohol testing, but also had training products
- Inability to reach consensus
- Participants' lack of authority to act on the group's consensus (facilities v. CFO)
- No consistent industry-wide representation

SWOT

To ensure workgroup participants had a realistic, multi-dimensional view of their key idea, the group analyzed it within a SWOT framework. The following table highlights the strengths, weaknesses, opportunities, and threats associated with the re-creation of a construction industry consortium/institute:

Strengths	Weaknesses
<ul style="list-style-type: none"> ■ One voice that can speak for all across the construction industry ■ One-stop shop ■ Getting all stakeholders at the same table ■ Ability to build on previous successes ■ Identifying individual participants ■ Individuals with real-world, hands-on experience (SMEs) 	<ul style="list-style-type: none"> ■ Size of group ■ Identifying individual participants ■ Size and influence (region vs. state)
Opportunities	Threats
<ul style="list-style-type: none"> ■ Communicate/educate on cost vs. value vs. risk ■ Focal point publicizing info/best practices ■ Intellectual property for sale or license, as a funding source ■ Serving as the single construction resource to the MEDC ■ A place to showcase the progressive thinking of Michigan Construction ■ Opportunity to unify the state's resources 	<ul style="list-style-type: none"> ■ Lack of consistent funding/support ■ Lack of dedicated full-time/part-time staff (admin) ■ Getting all stakeholders at same table and committed ■ Finding early success ■ Potential involvement of non-SMEs (e.g., academic consultants without field experience) ■ Intellectual property conflicts

The SWOT analysis process and related discussions inspired the workgroup to identify some issues that would need to be addressed during the consortium/institute design process. These included the need to ensure that actual decision-makers were involved in the proposed consortium, to overcome the current fractures in the industry, and to define the geographic boundaries of the entity. Based upon feedback from the morning plenary session, the group also acknowledged the need to demonstrate a relationship between the consortium/institute activities and increased productivity in the industry. This led to a discussion about strategies to quickly demonstrate the success of the new entity, and its value to stakeholders. A related conversation centered upon the need to identify a “driving force” that would attract stakeholders to the consortium/institute, and make the entity’s purpose clear from the outset.

Given the time constraints of the symposium, the workgroup participants determined that most of those issues should be discussed and resolved by a core planning group or steering committee, which will convene before the end of November 2011. However, the workgroup did spend a few minutes brainstorming possibilities for a slogan that would be useful in the consortium’s marketing effort, including:

- Michigan: Turn Here
- Michigan: Build Here
- Michigan: Live Here
- 3000
- Turn the Lights Back on in Michigan
- Where Visionaries Stay
- Where Visionaries Build
- Engine for Innovation
- Build with the Best
- Construction Productivity. . . Got Wheels?
- Michigan Center for



Figure 45: Strategy Workgroup Consortium Model

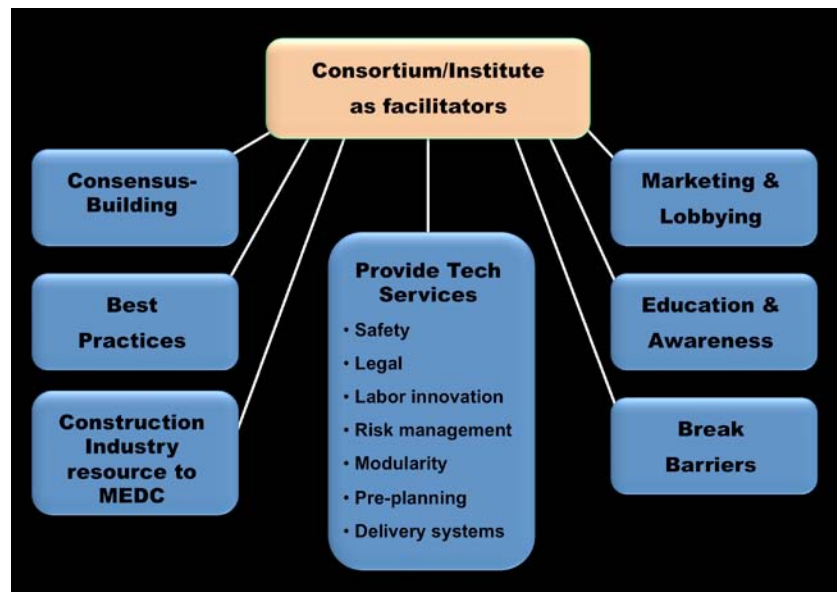


Figure 46: Strategy Workgroup Consortium Model

- Construction Excellence
- Produce Construction Improvement
- Build it Right, Here
- Build it Right Here, Together
- Michigan Advantage
- Michigan Innovative Construction Hub

A variation of the consortium/institute model was also developed, which clusters the areas of expertise provided by the new entity under the heading

of Technical Services (at right). The workgroup did not reach consensus about which version of the model would be ideal, but felt that the models could serve as a starting point for the core planning group and steering committee.

REPORT TO PLENARY

The Strategy Workgroup based its plenary report upon the action plan developed to move ideas forward. The RASI chart follows.

RASI EVALUATION

Create an institute/consortium to strategize and act (or problem-solve) on Construction: Advantage Michigan, by February, 2012:

Action Item	(R)esponsible	(A)uthority	(S)upport	(I)nform	Timeframe
Representatives from the four symposium work groups convene to form a core planning group (CPG)	Pat Devlin Bill Terrasi Mike Haller Technology: Bob Mauck Culture: Don O'Connell Legal: Michael Cooper	ESDI	ESDI (admin assistance) Ed Hartfield	Symposium participants	September 14, 2011 First meeting, ideally within September, but within 30 days for certain.
Create a value proposition, that will inspire individuals to commit to be part of the new organization	CPG	CPG	ESDI	Symposium participants	October 30, 2011
Connect with State of Michigan (including MEDC), to share the vision of the consortium (one-pager)	CPG	CPG	ESDI	Governor's office MEDC MDOT County governments Municipalities	October 30, 2011
Determine a rallying cause, which may be similar to the mission statement (i.e., need for jobs, increasing productivity, investing in the future, industry sustainability, image change, etc.)	CDG	CPG	ESDI	Symposium participants	October 30, 2011
Establish a steering committee (including labor, owners, contractors, AE, at least 2 each)	CPG	Companies authorizing employee participation	Symposium participants	Symposium participants	November 30, 2011
Develop a preliminary flexible/adaptable model, including governance structure, mission, vision, guiding principles	CPG	Steering committee	ESDI	Symposium participants	November 30, 2011
Create a preliminary business plan, staffing plan and funding scheme for the consortium/Institute	CPG	Steering committee	ESDI	Symposium participants	November 30, 2011
Brainstorm potential invitees, and identify owner champions for each industry sector	CPG Steering committee	CPG Steering committee	ESDI	Symposium participants Industry members Trade/ Professional organizations	November 30, 2011

Action Item	(R)esponsible	(A)uthority	(S)upport	(I)nform	Timeframe
Recruit companies as consortium members, leveraging the structures of existing organizations Build awareness of the initiative among the broader community (at upcoming ESD and other events)	CPG Steering committee	CPG Steering committee	ESDI	Symposium participants Industry members Trade/ Professional organizations	January 14, 2012
Create definitions of success (metrics) that will keep the owners (and therefore, other stakeholders) involved in the initiative	CPG Steering committee	CPG Steering committee	ESDI	Symposium participants Industry members Trade/ Professional organizations	January 14, 2012
Present preliminary consortium concepts and documents to trade/professional associations	CPG Steering committee	CPG Steering committee	ESDI	Symposium participants Industry members Trade/ Professional organizations	January 14, 2012
Identify a high-profile project that highlights the value and success of the consortium quickly.	CPG Steering committee	CPG Steering committee	ESDI	Symposium participants Industry members Trade/ professional organizations	TBD
Finalize business plan, staffing plan and funding scheme for the consortium/institute	Steering committee	Steering committee	ESDI	Symposium participants Industry members Trade/ professional organizations	February 1, 2012
Ground-breaking/ribbon-cutting for consortium, with all of tasks above completed and basic structure in place	Steering committee	Steering committee	Governor Rick Snyder ESDI	Symposium participants Industry members Trade/ professional organizations	February 1, 2012

☒ Culture Workgroup

FOCI:

- "Michigan embraces a culture of success."
- Culture change begins at home and at the top
- Quality is centered on growth and collaboration
- Shared risk and reward holds high promise, but is contentious

INTRODUCTION

This report highlights the process in the culture workgroup. The group began by reflecting on the purpose of the discussion, and immediately gravitated to the concept of trust and understanding. This set the stage for working together. The group was reminded to feel free to be controversial, but respectful, and use the benefits of coming from diverse backgrounds. This helped conjure the concept of a model force environment. The center of their discussions was the question:

If you were developing a construction workforce environment to increase productivity, efficiency and industry competitiveness, what would it look like and how would you implement it?

Group members identified concepts to focus on and chose through voting to pursue concepts of competitiveness, efficiency, and productivity in the construction industry, which were introduced during the informative plenary sessions. The resulting top identified ideas were: education and training; code adoption/system of legacy; high level of performance, trust, sharing, and respect; and collaboration. After completing a detailed discussion on prioritizing the key elements of the work environment, facilitators asked the group to consider how these elements could be implemented when the group prioritized its final key ideas.

BRAINSTORMING

The group got very specific and began with defining what the culture should look like, a Utopian concept of the workforce environment in a 21st-century Michigan. A group came up with a great statement, "Michigan embraces a culture of success." Simple, elegant; and then what was meant by this statement was discussed. The group said the

idea of culture is where all stakeholders—owners, operators, everybody else—are working together to improve the safety and the quality of a project while reducing costs and improving schedule. They felt the statement captured the theme, the notion and moved out of the fragmentation, out of the "blame game."

The group then went through the attributes of the theoretical Utopia and decided which would sustain the mission of moving beyond blame and fragmentation. Identified were these: mutual trust; social responsibility, not just within a project or zone, but also being aware of all the other outside influences and forces, whether it's local, state, national, or international. This is the notion that collaboration needs to be a philosophy; the idea of an inclusive project design where everybody has a voice from start to finish, that stakeholders are brought in early, the notion of accountability. The buck has to stop somewhere, but it stops within each peg of the project, as well as perhaps at the top of the food chain.

When discussing the sharing of risk and reward, much was considered about the concept where stakeholders have motivation to share risk and reap reward; mutual respect, that again goes to honoring the skill sets that particular cultures or work groups bring to the project. The ideas of remaining flexible, being open, innovative, willing to grow (associated with education and training), because if you don't grow you die. The idea that we're focused on the quality of the product and the work ethic that it takes to get there; establishing the code of excellence; what's your A-list team look like, who are they, what do they do, what do they exemplify, what do they model, what behaviors and conduct do they have to make all of these other things pull together; and what are the common goals of that project or that activity and making sure those are identified and shared so people understand what the must-haves and the result will be.

There was some struggle with the idea of how labor shares in the risk and reward and no consensus was reached on this specific item. Many felt that this concept really needs more in-depth study and understanding of how it could be possible. When the group examined the silos, there was hope that the formation of a new organization would bring these silos down, but responsibility was given to existing groups. For example, the responsibility for labor would go to Michigan Building Trades; then for the contracting community, the AGC or CAM were both identified, as well as CII or MOCA for the owners, and then ESD or ACEC for designers and engineers.

ASSESSMENT

SWOT

The table below shows strengths, weaknesses, opportunities, and threats related to implementing culture shift:

Strengths	Weaknesses
<ul style="list-style-type: none"> ■ Bonus system to spread success ■ Collaborative attitudes = productive behavior 	<ul style="list-style-type: none"> ■ How does labor benefit/share rewards? ■ Labor moves job to job, transient ■ Labor: no sense of control; possible lack of experience and education of business owner rationale
Opportunities	Threats
<ul style="list-style-type: none"> ■ Bonus system to share rewards, o chain ■ Labor rate, sliding scale tied to results ■ Labor helps create work rules that have room for modular, technology, productivity ■ Bring labor in at design stage ■ Training lecture “Bus 101” 	<ul style="list-style-type: none"> ■ Contracts: language (tone), restraints/regulation/ requirements ■ Labor/union perception ■ Legal ■ Competition with other states/sites

REPORT TO PLENARY

The group looked at the stakeholders and we broke them down into four segments: owners, labor, contractors, A/E designers. The group took its attributes and decided who should be the main entity trying to drive this attribute; in other words, the responsible party being the driving force. To no one’s surprise, everything stopped up at the top of the food chain with the owners.

However, the group attempted to mitigate the burden and took some of these attributes, and considered: the main attribute for the owner is setting up an atmosphere in a spirit of collaboration and cooperation, and that should ease a lot of the issues that might happen in the course of a project. So the group set its secondary attributes, which is everything else, and said, “as owners, these are action items you could do to enhance and further that culture.” The same thing was done for labor, the contractor, and A/E and designers. The group backed up even further and said, “well, all this is great in theory, but who’s going to do this, where do we go, how do we publicize this?” The group used a modified RASI chart to assign responsibility and determine the driving force behind all of these attributes to sustain this culture.

And so the seed is planted to say, this has been a great exercise for all involved, but the group would really love for everyone to make some immediate changes in their own environment to start to lead by example, because in the end, everyone agreed in this group that leadership is the key, whether you’re the owner, contractor, developer, the A, the E, the D, the X, the Y, the Z. Leadership and modeling the type

of behavior and culture you want is the only way it’s going to become systemic. It’s fluid, it’s dynamic, it’s ever-changing, and that is how the culture workgroup broke down the task in building the 21st-century construction force culture.

RASI EVALUATION

The group began with the end in mind, and one of the consensus items was that RASI doesn’t fit well when discussing culture. With that considered, the group attempted to put the square peg in the round hole, and came up with the characteristics a positive workforce environment would bring. In the modified RASI, big Rs are the person who’s the driving force; a lot of identify owners. But the group also saw opportunities here, noting that the responsible party isn’t always just one source. So in terms of a commitment to continuous improvement, they felt everybody has responsibility for that, and that’s a selling point to anybody coming to Michigan. The group talked about small responsibilities, which are represented by little rs. So while the group thinks perhaps the contractor is the one who can create and maintain the code of excellence, it may also be true that everyone has some responsibility in the supply chain for that commitment.

Similarly, if support is sought on some of these attributes, in a way, everybody is a supporter and everybody is informed, but the group tried, again, to identify them singularly. That said, if one is the responsible party or the authority or the support source, one already has the information. In

keeping with RASI, the group set some recommendations, because everybody wants to know what is happening next, and so a list was created in terms of what things might go further to produce this culture. One of the key points was: “you’ve got to get this out. What are you going to do tomorrow?”

Are you going to go back to your homeland, your office, your work environment, and what two or three nuggets are you going to take to help to begin to drive the culture, the technology, the strategy, the law, whatever it is? Because change begins internally at the home office.”

Responsible Party Owner (MOCA)	Responsible Party Labor (Building Trades Council)	Responsible Party Contractor (AGC/CAM)	Responsible Party AE/Designers (ESD)
Main Attributes			
<ul style="list-style-type: none"> ■ Collaboration 	<ul style="list-style-type: none"> ■ Code of Excellence 	<ul style="list-style-type: none"> ■ Quality of product 	<ul style="list-style-type: none"> ■ Commons goals
Secondary Attributes			
<ul style="list-style-type: none"> ■ Mutual trust ■ Social responsibility ■ Collaboration ■ Inclusive ■ Accountability ■ Sharing risk/reward ■ Mutual respect ■ Flexible ■ Quality of product and work ethic ■ Code of excellence ■ Common goals ■ Education/training growth promotion 	<ul style="list-style-type: none"> ■ Mutual Trust ■ Social Responsibility ■ Collaboration ■ Inclusiveness ■ Account ■ Common goals ■ Ongoing Education growth ■ Quality of product 	<ul style="list-style-type: none"> ■ Mutual trust ■ Social responsibility ■ Collaboration ■ Inclusive ■ Accountability ■ Sharing risk/reward ■ Mutual respect ■ Flexible ■ Quality of product and work ethic ■ Code of excellence ■ Common goals ■ Education/training growth promotion 	<ul style="list-style-type: none"> ■ Mutual trust ■ Social responsibility ■ Collaboration ■ Inclusive ■ Accountability ■ Sharing risk/reward ■ Mutual respect ■ Flexible ■ Quality of product and work ethic ■ Code of excellence ■ Common goals ■ Education/training growth promotion
Action Items			
<ul style="list-style-type: none"> ■ Set/establish atmosphere for working environment ■ Common goals ■ Contracts, language ■ Logistics ■ Scheduling (realistic) ■ Internal organizational culture ■ Open communication ■ Open information flow ■ International benchmarking 	<ul style="list-style-type: none"> ■ Good work attitude ■ Safety ■ Skill/training ■ Understanding/willing to engage; fit the entire process (early engagement) ■ Flexible (adopt) ■ Classification of work group ■ Awareness of external complications ■ Identify/give voice to improvement ■ International benchmarking 	<ul style="list-style-type: none"> ■ Work ethic ■ Define cost effective processes & resource planning ■ Continually identify and eliminate waste ■ International benchmarking 	<ul style="list-style-type: none"> ■ Communication/ collaborator ■ Quality of product ensure & enforce ■ Accountability, manage & direct within the chain of project (global A/E designers) ■ Drive innovation & creativity ■ Flexibility ■ International benchmarking



Attributes	Owner	Contractor	AE/Designer	Labor
Mutual Trust	R(esponsible)	r	r	r
Social Responsibility	R	r	r	r
Collaboration	R	S(upport)	S	S
Inclusive	R	S	S	S
Accountability (Get out of blame game)	R	r	r	r
Common Goals	R	S	S	S
Shared Risk & Reward	R	S	S	S
Mutual Respect	R	r	r	r
Flexible	r	R	r	S
Quality Product & Work Ethic	R	r	r	r
Code of Excellence	r	R	r	r
Education/Training/Continuous Improvement	R	R	R	R

Note: If you are an R, A(uthority), or S, you are I(nformed). R is a driving force; r is a small responsibility.

Technology

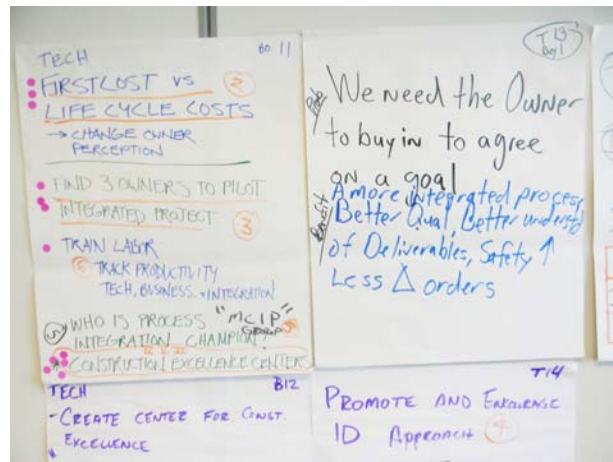
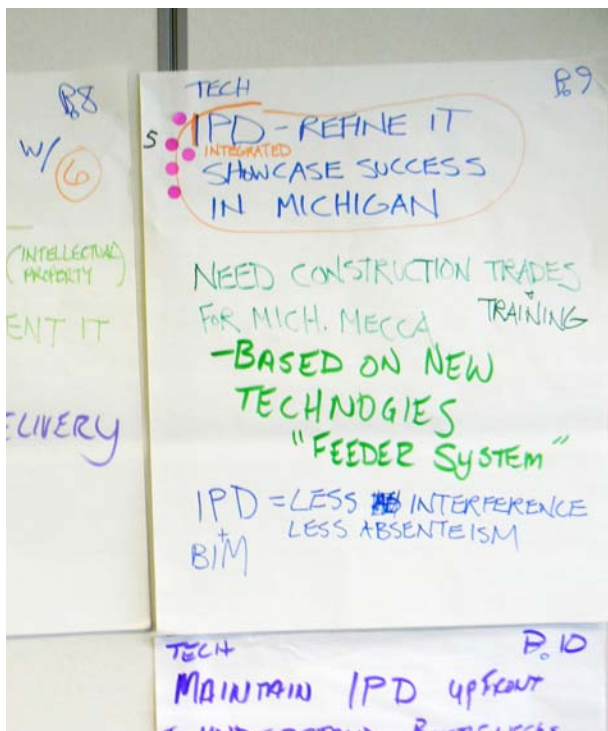
- FOCI:**
- Methodology
 - First costs vs. lifecycle costs
 - Owner-piloted programs
 - Construction excellence centers

INTRODUCTION

The technology workgroup got off to a cautious start. There was initial hesitation to discuss certain topics, and discussion over what was relevant to the question at hand, which was:

If you were creating a productive, efficient, and competitive construction industry using technology and lean principles, what would it look like and how would you implement it?

But the group ended up being quite prolific and eventually came down to four action items in fine fashion. The first of these is design and integrated construction process; this concept began with words like “methodology” and had buzz words like “BIM” and, after much discussion, the group decided it was really applicable technologies. The group also further explored conceptual pilot programs, the creation of a technology methodology team.



BRAINSTORMING

The workgroup brainstormed many topics and themes during the workgroup discussions, and the following four emerged as top contenders:

- Hold “risk charettes” with owner, design, and trade reps and talk honestly about what typically goes wrong and what big things could go wrong, create strategies to elevate, mitigate, or massage those risks
- Create a quality-based standard of design and construction
- Reintroduce and support proper and complete front-end planning on all project endeavors
- Project must use a single, highly visual planning method informed by those who do the work to make the full supply chain visible so that it can be managed

Hurdles that were dealt with from the outset were reasons that impede outside entities doing business in Michigan. These included the perception that no one wants to take a risk, there is no government support, and the need for an attitude adjustment.

They addressed these in four priority action items. The first was the development of a methodology that could be adopted to demonstrate a competitive edge to owners. Integral to the success of such a methodology is pulling away from the classic design/bid/build format, which was determined to create silos. The second priority of the group was the advantage of projecting lifecycle versus first cost. The group also felt there should be fostered collaborism in the form of “Construction Excellence Centers” to publicize and share successes and failures, include MCIP as process integrators, and align education with new integrated process (collaborate with universities, trade schools). The group felt these implementations need to be aligned with the outcomes of the Global Freight Hub symposium.

ASSESSMENT

SWOT

In order to realistically address the possibility of implementation with the four action items arising

from brainstorming, the group applied a SWOT analysis to each:

Methodology – Technologies / integrated process / database

Strengths	Weaknesses
<ul style="list-style-type: none"> ■ Integration/automation of materials and methods ■ Technology training ■ Initiatives are in place to get software we need 	<ul style="list-style-type: none"> ■ Not everyone is using the same technology ■ Not integrating into process ■ Training & staff knowledge of software ■ Design model vs. actual as build model ■ Some software (BIM) is a moving target
Opportunities	Threats
<ul style="list-style-type: none"> ■ Implementation ■ Laser scanning can increase productivity in D&C ■ Coordinate installation with trades ■ Materials and methods to increase productivity 	<ul style="list-style-type: none"> ■ Varying usage of technology ■ Define technologies ■ Integrate software ■ Software company dominance ■ Will new technology be code accepted ■ Scared of new technology

First Cost vs. Life Cycle Costs

Strengths	Weaknesses
<ul style="list-style-type: none"> ■ All owners in Michigan are buying first cost ■ Ability to give the owner information earlier by using available data 	<ul style="list-style-type: none"> ■ Buying first cost, economics of Michigan ■ Analysis of first cost vs. life cycle costs time and energy ■ Communicating operating costs
Opportunities	Threats
<ul style="list-style-type: none"> ■ Evidence needed to prove use ■ Pilot projects using life cycle costs 	<ul style="list-style-type: none"> ■ Making decisions on first cost could require more money in the long run ■ Owners willing to use life cycle costs ■ Competitive tools and training are a large investment

Owners to Pilot Integrated Delivery System (3 test pilots)

Strengths	Weaknesses
<ul style="list-style-type: none"> ■ Level of interest in improving delivery ■ Bring creativity/innovation back ■ Have to show value add to owners 	<ul style="list-style-type: none"> ■ Willingness to participate
Opportunities	Threats
<ul style="list-style-type: none"> ■ Test various company (function) and sizes ■ To prove value ■ Eliminate waste through coordination 	<ul style="list-style-type: none"> ■ Culture ■ Gap old ways vs. new

Construction Excellence Centers

Strengths	Weaknesses
<ul style="list-style-type: none"> Single vision Data resource Government 	<ul style="list-style-type: none"> Lack of owner participation Different organizations vying for money and participation (prof associations) Government
Opportunities	Threats
<ul style="list-style-type: none"> Create something sustainable Education Funding, incentives 	<ul style="list-style-type: none"> Lack of funding Lack of alignment

REPORT TO PLENARY

The report to the plenary was centered wholly on the RASI evaluation presented in the next section. Additionally, during the report to the plenary, group members shared an important issue not directly addressed in the chart. A member of the group was very adamant that the education of the trades on the use of cutting-edge technology was a necessary item,

because it could save a lot on labor costs; the specific context of concrete and sheet metal were given as specific examples. There was concern that labor was not mentioned at all in the group’s RASI chart. It was mentioned, however, that the idea of owner-piloted programs was discussed with a cross-section of actual owners, who were reportedly receptive to the idea.

RASI EVALUATION

Action Item	(R)esponsible	(A)uthority	(S)upport	(I)nform
Design integrated construction process	Integration team (CM, AE, Owner’s rep)	Owner	Consultant/facilitator	Stakeholders
Create a cost model/life cycle cost report	Owner’s rep	Owner	Consultants	Owner
Create pilot program	Owners rep, integration team	Owner	Facilitator, consultants, subcontractor	Stakeholders
Create the technology methodology team needed to provide education on the technology resources available (hardware/software) at the Construction Excellence Center/ Consortium	Team member	Investor/owner	SME, Consultant	Consortium

Legal

FOCI:

- A conceptual model contract for integrated delivery
- Defining the complete design
- A modern labor/management agreement

INTRODUCTION

The legal workgroup began their task by closely considering the scratch question:

If you were establishing a commercial framework to foster an increase in productivity, efficiency, and industry competitiveness, what would it look like and how would you implement it?

Brainstorming began almost immediately as the participants entered the room. An inclusive discussion and analysis then led to measured steps for moving forward, as recorded in the RASI section below.

BRAINSTORMING

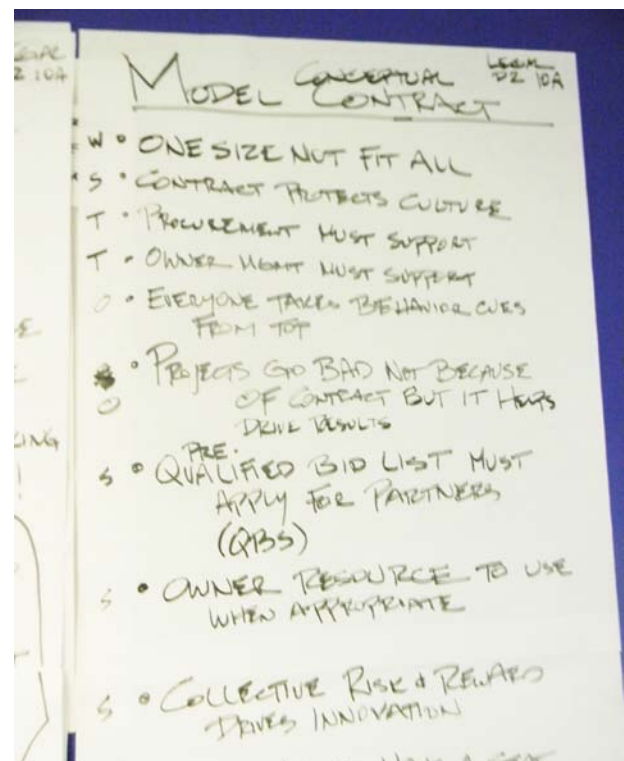
Five ideas were conceived of rather quickly within the group. The first— and most time-consuming—is the idea of a model contract. This is a contract that would work for the construction industry. Collective risk management, shared rewards, common terms and conditions, and an equitable approach so all parties to a project feel as though they are in it together, as opposed to an ad hoc, “let’s see what happens” approach to project relationships. From a standpoint of efficiency and productivity, the group felt it important that everyone is on board with the approach and the events of a project.

The second supported idea was that of an industry action group, which was an overlap with the Strategy workgroup and further explored in that setting. It was important to the legal group that this industry action group (IAG) had high owner involvement. A function of the IAG would be to provide a consensus baseline for project performance: how the industry as a whole is doing, how to judge how projects are going, industry productivity information, and so on. The legal group also discussed QBS (qualifications-based selection) as important and felt the IAG could help drive the industry in this direction. The sentiment was, if the right team is not on the project, it’s difficult to be productive and efficient.

Defining the concept of complete design was also discussed. What, exactly, is a deliverable when we talk about design? This includes a construction team deliverable when talking about integrated delivery. It was acknowledged that it could vary depending on the project approach—IPD, design/bid/build—but what the group determined was if there isn’t agreement on what defines a deliverable, productivity and efficiency are negatively affected. It is very difficult to realize an objective without agreement on what said objective is.

The legal group also brainstormed the concept of a labor/management operating agreement with a modern approach, which addresses trade jurisdiction, portability, and the cost of labor, including long-term liabilities. The group felt these issues are costing Michigan and wanted to sit down and have a conversation to determine whether the bar could be raised.

The fifth and final idea to come out of brainstorming was described as lukewarm support, but was discussed with moderate substance: metrics for construction productivity. At the plenary session there was much discussion around data, and how data in the construction industry isn’t as reliable as, for instance, manufacturing. There are many negative issues associated with data: proprietary information owners might have, data security, legal barriers, and so on. The group felt this was worth mentioning, but chose not to explore it at that time.



ASSESSMENT

A formal SWOT analysis of ideas was not performed in the legal workgroup. Instead, characteristics that had already been identified were retroactively classified as a Strength, Weakness, Opportunity, or Threat. The following tables represent the results of this categorization:

Model Conceptual Contract

Strengths	Weaknesses
<ul style="list-style-type: none"> ■ Contract protects culture ■ Pre-qualified bid list must apply for partners (QBS) ■ Owner resource to use when appropriate ■ Includes procurement procedures ■ Collective risk and reward drive innovation ■ Stakeholders have a seat at the table (core group) ■ Managers risk for partners losing money ■ Owner/accountability team ■ Team part of validation process 	<ul style="list-style-type: none"> ■ One size does not fit all ■ Tough for utilities (low bid beats? Rents)
Opportunities	Threats
<ul style="list-style-type: none"> ■ Everyone takes behavior cues from total ■ Projects go bad not because of contract ■ but because it helps drive results 	<ul style="list-style-type: none"> ■ Procurement must support ■ Owner must support ■ Need to compete S.O.W.

Define Complete Design

Strengths	Weaknesses
<ul style="list-style-type: none"> ■ Common DES/construction deliverable ■ Engineer in responsible change; signs & seals docs ■ Collaborative decision-making ■ Minimize risk or rework ■ Steps of document development ■ Focus on level of decision not DWG completion ■ Definition of responsibility of parties; no gaps 	<ul style="list-style-type: none"> ■ 30-60-90 ■ Will vary w/projects ■ Tough for utilities to use
Opportunities	Threats
<ul style="list-style-type: none"> ■ Ownership of BIM model ■ 100% COs? What are shops? ■ NIBS "Building Smart" level 100-500 document definition standard ■ Work toward "Deliver the model," no drawings (better documents; state support; ICC) 	

Define Complete Design

Strengths	Weaknesses
<ul style="list-style-type: none"> ■ Let contractors make project labor decisions based on need 	<ul style="list-style-type: none"> ■ Pension Protection Act (Congress) must fund for all members (legal issue) ■ Union contractors have trouble competing w/ non-union in Michigan ■ Unfunded pension/HC liabilities ■ Federal law: you can't make retroactive changes in benefits
Opportunities	Threats
<ul style="list-style-type: none"> ■ National Maintenance Agreement MA ■ Trade jurisdictions/mobility work rules ■ Let contractors make project labor decisions based on need ■ Go to national labor orgs (locals cannot override) 	<ul style="list-style-type: none"> ■ Cost issued to fringe benefits, not wages ■ <i>Green Book of Decisions</i> as governing reference is out of date ■ Foreign construction companies subsidized by their governments come to U.S. and win public work

REPORT TO PLENARY

The legal workgroup report to plenary added some depth to the created RASI evaluation chart, which follows this section.

A conceptual model contract for integrated delivery would include commentary on the procurement process because it has to support this agreement. If you go through a procurement process that doesn't support the model agreement, it will not work at the end. And because one size does not fit all, it is important to set a framework to provide a resource for the community that included discussion of a procurement.

In this inclusive vein, the ideas generated by the legal group were very important from a culture perspective: they discussed shared risk, responsibility, opportunities for reward, working together, collaboration. The group agreed that when we're all in it together, when everyone has "skin in the game," when we're making decisions together, we don't have the strife that the industry is often known for. Additionally, there was a large owner presence in the legal group and they were receptive to the idea of a conceptual model contract. Members of the design community also expressed high interest in working in the type of environment that would be created by a conceptual model contract for integrated delivery.

The owner community will need to approve this idea because they will decide whether or not to use it. The legal community was also looked upon for support, as was Digby Christian, specifically, who is able to relay real-life experiences from the Sutter

project, which encapsulate several of these ideas on a large scale. The group also determined that everyone should be informed of the creation of this model contract for integrated delivery; it is revolutionary, and when the perception of Michigan is discussed and what we need to do as a state, it's not just the industry that wants to know: everybody wants to know.

In discussing better defining the completeness of design, there was dialogue around evaluating and adopting the Building Smart Document Definition Standards. A specific point was a lack of agreement on what it means to be 30 percent done, 60 percent, 90 percent done; this lack of understanding and agreement and the resulting use of documents that may not be appropriate for a specific purpose. The group felt strongly that a common understanding would be appropriate, and the Building Smart Standard is a system in existence that is appropriate to evaluate and perhaps adopt.

Falling under the heading of definition of completeness, one group member suggested, "Why don't we get rid of paper documents completely?" There was much expression concerning the risks around 2D drawings, which lead to, "why don't we deliver building models in lieu of paper documents?" They're better-quality documents, they have more information, they strip waste out of the job, and these are all desirable outcomes for improving productivity.

There is an effort to carry this out, but this group wants to head in that direction and it's a step that will need to be backed by the owner community, as they

will have to buy into the notion of working off the model and paper being a thing of the past. The ICC will need to support models that will have to be sanctioned as acceptable, and the original equipment manufacturers will be necessary for information population of the model. During the report-out, it was pointed out that the government would be necessary for revising permits, with which the group agrees and the Codes Council would be a good place to start because building officials will take their cues there.

The final idea discussed by the group was that of a modern labor/management agreement. Several points were discussed on this topic: the National Maintenance Agreement was considered as a basis for helping address work rules issues (portability, trade jurisdictions, etc). Pension funding also needs to be addressed through the federal government (Pension Protection Act) as well as in the legal

community. The group agrees that this is a powerful perception act: not only would it grant owner relief, but will have broad appeal nationwide to bring people to the state.

It is essential that international labor organizations grant their approval in exploring ways to address this topic, and the federal government needs to approve as well because there will likely be a legislative modification required. Other support may come from a number of specialists, including actuaries for pension processes that have more detailed information. The group is aware that there will be a lot of support to be called on for this effort, and was unsure as to whether they could adequately identify all the support necessary. The further exploration and undertaking of this issue was supported by everyone in the room, from owners to contractors to labor.

RASI EVALUATION

ActionItem	(R)esponsible	(A)uthority	(S)upport	(I)nform
A conceptual model contract for integrated delivery	Subcommittee of the industry action group (both public and private owners, architects, engineers, contractors, labor)	Owner	Legal community; professional societies (i.e., ABC, AIA, MSPE, ESD); Digby Christian	Everyone
Defining complete design	Subcommittee of the industry action group (architects, engineers, contractors)	Stakeholder community (groups speaking for architects, engineers, contractors, etc.)	Owners; labor	Industry
Delivery of building models in lieu of paper documents as standard practice	Subcommittee of the industry action group (architects, engineers, contractors, owners, labor)	Stakeholders	International Code Council; original manufacturers; legal	Industry
Modern labor/ management agreement	Subcommittee of industry action group (owners, contractors, laborers)	International labor organizations, federal government	International labor organizations policy committees, NTCMP, legal	Everyone

Concluding Observations

Nineteenth century journalist H.L. Mencken said, “the world always makes the assumption that the exposure of an error is identical with the discovery of truth, that the error and the truth are simply opposite. They are nothing of the sort.” This, the concept of the truth lying beyond the identification of error, is exactly the principle on which the Institute is based. Mencken goes on to say, “what the world turns to, when it is cured of one error, is usually simply another error, and maybe one worse than the first one.” The consensus on finding the truth, a viable solution to turn to, was never highlighted so well as the conclusion of the Construction Productivity symposium.

Our symposium attendees engaged in a two-day envisioning effort to realize a new construction environment that will sustain consensus-based projects, foster innovation and implement “win-win” best practices that will challenge the world in terms of productivity and competitiveness. The newness of what transpired was not always in the information, but in the audience. Much of what was presented had been discussed before, but in the fractured enclaves of individual offices, companies, trades. The new, then, is the components of construction and design having these conversations with each other; the next is wide implementation, heeding the call of one voice.

Michigan is on the cusp of transformation if we implement the work of this symposium. There are projects in the field happening right now, using IPD and ID, principles that are successful at addressing major hindrances in the state of Michigan construction. While this is a hearty relief for the parties to individual projects, ground-up is a slow method of turning around the effectiveness and reputation of the industry connected to an entire state. Our participants said, “let’s examine how we can [and not why we can’t] make Michigan the best place for construction.” The results of the symposium repeatedly highlighted the principles that emerged from the workgroups, unified in one voice.

So, what really happened over those two days of hard work at the Institute by close to 80 leaders from all sectors of our economy?

First, our workgroups recommended that the stakeholders put some skin in the game. That’s right. There is nothing wrong with volunteer efforts but if you bet some cash, you’ll “mind the shop,” as they say. Past efforts at coming together have had the fundamental flaws of no seed dollars and discretion in funding that with changing *personnel, politics* and *priorities* (the Three “P’s”), doom any effort that is outside the box.

Second, we decided to tackle the one of the three “P’s” in our Institute recommendations: *politics*. Let’s put some teeth in the State’s buying power by the incorporation of best construction practices when public dollars are spent. The state will set a standard for construction and project execution that will raise the bar and lead the way for others to follow. Whether this occurs by an executive order from the Governor or legislative action, we intend to push the envelope to make a beneficial change during these difficult times.

So, how can the brand of “Made in Michigan” be our State’s new economic model? To be a bit argumentative or alternatively to state the obvious, politics is compromise that has a certain disdain for best practices. It assumes that it is a bit naïve to think that anyone can craft something that would be the envy of the world and kick the posterior of naysayers. Expediency is the only achievable prize.

Well, we didn’t settle for expediency at this symposium, that’s for sure. Integrated Delivery is the game changer. Never before was any idea embraced so broadly by so many since the Institute was formed, perhaps because the real-time results are so impressive. It is not just a start, but the confirmation of years of hard work.

Let’s make the recommendations of this report a reality, discard the perception that management and labor cannot work together, dispel the notion that old buying practices are still the safest way to go. We only risk the opportunity of driving out construction waste, inefficiencies and costs.

If we implement the methodology of Integrated Delivery for construction as a statewide practice—perhaps beginning with ID principle mandated on public projects—our manufacturing turnaround is not far behind. We will indeed design, supply and construct the products the world wants. The fundamentals of economic growth will gain solid footing.

And with Michigan’s strategic advantages of workforce talent, water, location, vacant land, and infrastructure, we will be the player on the global stage turning Michigan into a sustainable export state that can’t be beat or to say it another way, will beat ‘em by being in fact and not in name the best of the best. Raising the bar is today the only game in town. And to recall a phrase we have used in the past, a crisis is a terrible thing to waste. Let’s use it to our collective advantage for all stakeholders, beyond simply identifying another error.

Stay tuned to our next symposium that will build on this symposium’s incredible achievement. A new model for manufacturing is in the batter’s box of implementable ideas. Construction just hit a home run.

APPENDIX A

ESD Board of Directors

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A Construction Productivity Symposium Abstract¹

“Identifying the Opportunities for Advancing the Competitiveness, Efficiency and Productivity of the Michigan Construction Industry”

The Engineering Society of Detroit Institute

www.esd.org

www.esdinstitute.net

Background Statement

The issue of efficiency in the construction industry is seldom discussed or studied at the national or state level. Recent developments indicate a need to address the issue in a collaborative manner.

Construction Industry at the National Level

The United States construction industry produces all types of buildings and infrastructure including homes, office buildings, hospitals, airports, manufacturing buildings, universities, roads, bridges, and water and sewer systems in every location across the country. In 2007, the construction industry accounted for \$611 billion or 4.4 percent of the gross domestic product (GDP) of the United States. If the value of the installed equipment, furnishings, and

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other elements necessary to complete a building were included construction would account for 10 percent of the GDP. The construction industry is also a major generator of jobs with 11 million people or 8 percent of the total U.S workforce employed in construction per the Bureau of Labor Statistics. The U.S. is the largest single country market for construction projects and it is extremely important that a leadership position in the construction industry be maintained.

Industry analysts differ on whether construction industry productivity is improving or declining. Some analyses for the industry as a whole indicate that productivity has been declining for 30 years or more. Other studies document improved productivity for construction projects and construction tasks. One area of agreement is that there is significant room for improvement.

A CALL TO EXAMINATION & IMPLEMENTABLE ACTION

This Construction Productivity Symposium will focus on the core Mega Question:

“How can Michigan create consensus for a model comprehensive construction implementation standard that will serve the needs of the 21st Century?”

The Symposium workgroups will focus on the following workgroup questions:

“If you were creating a productive, efficient and competitive construction industry using technology and lean principles, what would it look like and how would you implement it?”



“If you were developing a construction workforce environment to increase productivity, efficiency and industry competitiveness, what would it look like and how would you implement it?”

“If you were applying prefabrication and modular build strategy to increase construction productivity, efficiency and industry competitiveness, what would it look like and how would you utilize them?”

“If you were establishing a commercial framework to foster an increase in productivity, efficiency and industry competitiveness, what would it look like and how would you implement it?”

Next steps include the identification of the diverse stakeholder groups that should be invited to the symposium. Stakeholder groups would represent these interests.

<ul style="list-style-type: none"> • Contractors and Sub-Contractors • Consumer Owners • Construction Companies and Associations • Government (all levels) • Architects and Designers 	<ul style="list-style-type: none"> • Labor and Building Trades • Legal • Financial • Academic • Legislators (all levels)
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Conclusion

While the issue of whether construction productivity is improving or declining is up for debate, what remains clear is that significant room for improvement exists and is essential to the continued success and competitiveness of the construction industry. While previous groups have looked at policy issues, they have not



reached actionable consensus. ESDI's approach provides a neutral forum where consensus-based actionable deliverables can be conceived.

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"Chinese workers build 15-story hotel in just six days" by Brett Michael Dykes, A hotel is built in China over the course of 6 days which is soundproof, thermal insulated and able to withstand a magnitude 9 earthquake.
(http://news.yahoo.com/s/yblog_upshot/20101112/bs_yblog_upshot/chinese-workers-build-15-story-hotel-in-just-six-days)

Video : (<http://www.youtube.com/watch?v=E76uji744Do>)

About ESD and the ESD Institute

The Engineering Society of Detroit (ESD) is a 115 year old multidisciplinary nonprofit organization with a problem-solving mission. ESD's reach extends to over 65,000 engineering and scientific professionals consisting of over 6,500 individual members, 3,000



corporations, 52 unions, 154 construction companies, 86 technical societies, 38 higher education institutions, and 1,667 property owners and managers.

ESD formed its Institute (ESDI) in 2008 modeled in part upon the National Academy of Sciences. To state it simply, ESDI's Mission is consensus-building. Our goal is to provide an outcome neutral forum and process that encourages "problem solving" instead of "fault finding" through the application of inclusiveness and transparency. To achieve this goal, ESDI seeks to maintain neutrality with respect to the specific outcomes that result from our process. We are the "guardians" of the integrity of the process and not the "drivers" of any specific agenda or outcome that may result.

ESDI's Process

Over the past three years, the Institute has engaged in a facilitative and inclusive symposium process to bring diverse and often conflicting stakeholders together to identify implementable solutions that can benefit Michigan and serve as an example for application throughout the U.S. ESDI has modeled its work based upon the symposium process of the National Academy of Sciences (NAS) in Washington, D.C. ESDI, in collaboration with ESD Board Members and public and private sector representatives, crafts a mega question that is at the heart of the symposium deliberations. ESDI prepares an abstract or executive summary of the mega question to be considered and then identifies and invites a select group of diverse and often conflicting stakeholders to attend the formal symposium.

In addition, ESDI solicits presentations from leaders in the subject matter to set the stage for the work of the symposium. After the presentations are completed, attendees choose workgroups to generate breakthrough ideas utilizing proven facilitation and evaluation methods as described in the process methodologies contained on our website. ESDI then drafts its findings from the symposium and submits its draft report for peer review. Upon the conclusion of this step, ESDI publishes its final report of recommended solutions.

In a step beyond customary symposium practices, ESDI may, after ESD Board review, form implementation constituent workgroups made up of attendees and others to flush out the next



concrete steps to bring to realization the benefits of the unifiers and enablers generated during the formal symposium. These workgroups then craft specific action plans or programs such as business plans or other valuable deliverables and define the action steps which transform consensus-based ideas into real-world programs for Michigan's economic turnaround.

Previous ESDI symposia have included:

- **Prospectus Michigan and Green Enterprise Zones:** ESDI developed a new labor-management agreement and dispute resolution system and drafted enabling legislation (Michigan Investment Corporation Act) to create a virtual investment zone capable of maintaining and attracting sustainable investment in Michigan beyond the use of public funds or tax incentives.
(<http://www.esdinstitute.net/greenzone/index.htm>)
- **Blue Economic Development:** ESDI convened a Clean Water Steering Committee to build a policy consensus around the effective and sustainable use of water as key to Michigan's future job growth; ESDI volunteer engineers, working with the City of Detroit DSWD, developed a plan to correct long-term problems in the State's largest water and sewage system, independent of huge new infusions of public funding.
(<http://www.esdinstitute.net/water/index.htm>)
- **Right Sizing Local Government:** City and Township officials and residents in Davison Michigan adopted ESDI and its Partner's recommendations on leveling the millage, consolidating services, controlling legacy costs, marketing strategies and job training programs, that can serve as models for other municipalities.
(<http://www.esdinstitute.net/davison/index.htm>)
- **Future Detroit:** ESDI convened its first ever "youth symposium" gathering 107 Detroit middle school students and asking them to envision "Future Detroit." The symposium not only brought students together for a common goal, but unified leaders from the Detroit City Council, the Detroit School Board and the Mayor's Office, as



they all stood behind and supported this initiative to give young students a voice and a stake in their futures.

(<http://esdinstitute.net/futuredetroit/index.htm>)

Participation in the symposium is by invitation only and is usually limited to 70 attendees. We are in the process of gathering a listing of potential invitees of differing minds and interests to engage in meaningful and creative problem solving.

This Abstract has been prepared as an informational piece. It is intended to start the process and not to limit it in any way. Our goal is to report new and achievable ideas that can be implemented to benefit all. The Construction Productivity Symposium would be conducted in accordance with the process and peer review procedures of the ESD Institute. More regarding the Institute is available at its website www.esdinstitute.net.

If you have any questions concerning our Construction Productivity Symposium, please do not hesitate to contact us at the Institute. We thank you for your consideration in expressing an interest to join us.

Respectfully submitted,

THE ENGINEERING SOCIETY OF DETROIT INSTITUTE

APPENDIX B

Symposium Participants

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Black and Veatch

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MDOT

Digby Christian
Sutter Health

Dave Ciuffoletti
Durr Systems

Doug Conklin
URS Corporation

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Harley Ellis Devereaux

Jim Corsiglia
Harley Ellis Devereaux

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JA Lombardo & Associates

Matt Cramer
Dee Cramer

Jim Czarski

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Paul Sinelli
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Lynley Weston
Turner Construction

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Carlisle SynTec Roofing Systems

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Ford Motor Company

APPENDIX C

Symposium Report Peer Review Outreach

Randy Abdallah	John Boulahanis	Gino Del Pup	Glenn Granger	Michael Hughes
Tariq Abdelhamid	David Bourgeois	Michael Delano	Ginger Greager	Holly Hughes
Joe Abdo	Tim Bracco	Karen Dell	Richard Green	Bill Huizenga
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Justin Amash	Gary Broad	Steven DiBerardine	Kamesh Gupta	Matt Huuki
Jim Ananich	Cathy Brock	Mark Dickens	Ashok Gupta	Donna Inch
Charlie Anderson	Lisa Brown	Brandon Dillon	Jack Gurney	Jeff Irwin
Glenn Anderson	Chris Brown	Debbie Dingell	J. Ricardo Guzman	Alex Ivanikiw
Lee Andrea	Charles M. Brunner	John Dingell	Carl Haas	Yao Jack
Rich Applegate	Brad Bull	Bob Donaldson	Alan Hahn	Shanelle Jackson
Vera Ashford	Jon Bumstead	John Donegan	Gail Haines	George Jackson
Andrea Atherton	Andrea Burg	Tim Dooling	Norman Hall	Paul Jacob
Cheryl Aubuchon	Jerry Burgess	Tom Doran	Rick Hall	Bradford C. Jacobsen
John Austin	Robert Byrom	Jonathan Dropiewski	Robert C. Hall	Mark Jansen
James Avery	Barb Byrum	Paul Duhaime	Mike Haller	Nancy E. Jenkins
Charles Ayers	Andrew Calcaterra	Patrick Duke	Rick Haller	Randy Jobin
Jim Badgero	Brian Calley	Tim Duncan	Jack Hallman	Michael Johnson
Hank Baier	Mike Callton	Brian Dunn	Jeffrey Hamilton	Bert Johnson
John Balconi	Rick Carrithers	Frederick C. Durhal Jr.	Richard E. Hammel	Joel Johnson
Charles Ballard	John Carver	Dave Egner	Ki Hammer	Corian Johnston
Katherine Banicki	Tom Casperson	Majed El-Awar	Doug Hanna	Rick Jones
Ken Barnes	Bruce Caswell	Mahmoud El-Gamal	Goeff Hansen	David Joos
Vicki Barnett	Phil Cavanagh	Scott Elliott	Tom Hanson	Roger Kahn
Joan Bauer	Peter Cavanaugh	Judy K. Emmons	David Hanson	Albert Kaltenthaler
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Timothy Bischoff	Michael Cooper	Gerald Ganske	Dave Hildenbrand	Dennis King
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Richard Bither	Jim Corsiglia	Mario Garza	John Hiltz	Mike King
Timothy Bledsoe	Kevin Cotter	Douglas A. Geiss	Rudy Hobbs	Bob King
Dick Blouse	Dennis Cox	Robert J. Genetski, II	Morris W. Hood, III	Ken Knight
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Gerald Boerner	Jim Croce	Judson S. Gilbert, II	Hoon-Yung Hopgood	Kevin Koehler
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Dan Bollman	Frank D'Amore	Ben Glardon	Marcia Hovey-Wright	Yomi Kole-James
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Darwin L. Booher	Perry Daneshgari	Carol Glick	Lisa Howze	Ronald Koshewitz
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Mike Boss	Ketan Dave	John Gose	Brad Huff	Eileen Kowall

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Kevin Leitz	Charles Moss	Yogendra Rahangdale	Joel Smith	Loren Venegas
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Jim Meenahan	Phil Pavlov	Paul Scott	Isis Tomik	Ron Zonca
Jennifer Mefford	Dennis Pawley	Jim Sears	Angelo Torcolacci	Dale W. Zorn

Facilitator Biographical Information

Tracy Allen, JD

Tracy L. Allen is a full-time mediator, arbitrator, and ADR teacher. As a business, tax, real estate, and estate-planning attorney, she now specializes in national and international mediation, strategic management and design of corporate and cultural conflict resolution process, arbitration, and ADR training. Ms. Allen writes and teaches extensively throughout the world in her areas of expertise. She is a leading teacher of ADR in the United States and for several international organizations. As a former college and law school professor, Ms. Allen serves on the roster of several dispute resolution organizations. She is a graduate of the University of Michigan (BA) and Wayne State University Law School (JD; LLM, Taxation).

Michael Cooper, PE, LEED AP, FESD

Michael Cooper is a Managing Principal and Corporate Director at Harley Ellis Devereaux, one of the nation's oldest architecture, engineering, planning, and management firms. He has been involved in complex building projects for more than 20 years in both an engineering and management capacity. Mr. Cooper currently serves as Vice President of The Engineering Society of Detroit and is a Director of the American Council of Engineering Companies, Michigan Chapter. He is an adjunct faculty member at Lawrence Technological University and a featured author and speaker on both innovative design and business leadership issues.

Edward F. Hartfield

Edward F. Hartfield is the President of the Hartfield Resolution Group (HRG). HRG provides mediation, arbitration, and other third-party neutral services, including the design of innovative programs in negotiation, alternative dispute resolution processes, union management collaboration, partnering, and grievance resolution systems. He has been involved as a dispute resolution professional for over 35 years, including Commissioner with the Federal Mediation and Conciliation Service, Member of the Federal Service Impasses Panel, International President of the Society of Professionals in Dispute Resolution (SPIDR), State Mediator for the New Jersey Office of Dispute Settlement, and President of the Detroit Chapter of (LERA) during the 2010–2011 year. Mr. Hartfield has substantial construction industry experience with organizations such as MUST, GLCA, the IUOE 324 LMEC, and the Nova Board of Directors. He has served in a neutral capacity in contract negotiations, grievances, jurisdictional disputes, and problem-solving teams.

Jeff Hartfield

Jeff Hartfield joined the staff of the National Center for Dispute Settlement (NCDS) as a mediator/trainer in the Michigan offices in 2000 and has been involved with Elections Unlimited since its inception in 2001. He has a deep appreciation for the interests of labor and management and he has also been responsible for managing and administering the NCDS dispute resolution panel involving the Equal Opportunity Employment Commission. Mr. Hartfield provides contract negotiation facilitation to union and management negotiation teams during the collective bargaining process and prepares those groups for contract negotiations by providing training in mutual gains/interest-based problem-solving bargaining.

Christy Hicks

Building community capacity has been the consistent career theme of Christy Hicks, a Certified Professional Facilitator working at Michigan State University Extension. She is an active member of the International Association of Facilitators and the American Society for Training & Development. She is certified in a wide array of facilitative tools and methods, including the PATH strategic planning process and graphic iconography techniques. She is an alumna of AmeriCorps and VISTA, and volunteered more than 3,500 hours to build partnerships in Southeast Michigan. Her work in the community resulted in her being selected as the recipient of the 1999 Common Ground Award, which she received from President Clinton.

Theresa Harris, AIA, LEED, AP, EDAC

Theresa Harris is a Senior Associate and Manager of Health Care Planning at the Albert Kahn Family of Companies. She is a registered architect in Michigan specializing in healthcare facility planning and design. She is LEED certified by the United States Green Building Council and is also an Evidence-Based Design Accredited professional. She received her master of architecture and BS in architecture degrees from the University of Michigan. Recently she has led the medical planning for the Aurora Health Care Medical Center in Grafton, Wisc.

Alan Jaros

Alan Jaros is a Michigan State University Extension Youth Development Coordinator specializing in entrepreneurship and career exploration. Mr. Jaros has an extensive background facilitating outdoor educational experiences for the Bloomfield Hills School District of Michigan. An active member of the Greater Detroit chapter of the American Society of Training and Development, he has played an integral part in developing and implementing youth entrepreneurship initiatives to increase financial literacy and job readiness skills. Mr. Jaros holds a BS in human resource development with a concentration in training and development. He was awarded the 2006 Red Cross Heroes Award for philanthropic fundraising efforts on behalf of the Salvation Army.

Joel S. Milinsky

Joel S. Milinsky is Owner/Designer/Producer of Instructional & Communications Media Content for VIDTEL. His responsibilities are project management and, as an instructional technologist, developing linear and interactive programs under direct contract for education, institution, and industrial clientele. Other projects included maintaining the Workforce and Career Development site offering downloadable curriculum for the State of Michigan on MI Learning and work with The Michigan Association for Computer Users in Learning. Other aspects of his work include the design and development of hardware and software configurations for Internet video conferencing for collaboration and virtual classroom instruction.

James W. Ribbron

James W. Ribbron is with Michigan State University St. Clair County: District 10 as an Extension Educator for Economic Development. His area of expertise is in the Greening Michigan Institute of MSU Extension is Business & Entrepreneurial Development and Land Use Stewardship Education. Focusing on business solutions intervention and retention, product development and innovation, new venture entrepreneurial development and using culture to drive economic development. Past work experience includes Planner with the City Planning Commission of Detroit with duties focused on economic development policy analysis for the Detroit City Council.

Jerome Rock, JD

Jerome Rock serves in private practice as arbitrator and mediator for general civil, business, technology, and construction industry disputes. His subject matter qualifications are in construction, development, design and building disputes, engineering/technology issues, environmental issues, and complex commercial disputes. He holds a BS in mechanical engineering, MS in civil engineering, and a JD.

John M. Sier, JD

John M. Sier, JD, concentrates his practice in dispute avoidance and resolution of commercial, healthcare and construction contract issues as the head of the firm's construction and commercial litigation group. Mr. Sier has experience in analyzing legal aspects of various project delivery methods, including drafting construction contracts and assisting in dispute resolution and project completion. In healthcare, Mr. Sier has handled matters involving staff privileges, antitrust, Medicare, and third-party payer reimbursement issues and HIPAA compliance issues. He received his JD and MA in mass communication and journalism from Drake University Law School and Graduate School in 1986. He has published articles and presented seminars on construction, healthcare, and commercial issues.

Kristin Van Raaphorst, MPA/CED

Kristin (Stahley) Van Raaphorst serves as the Deputy Director for The Engineering Society of Detroit Institute. Her professional expertise is centered on technical economic policy; her work in the Michigan local government and nonprofit communities has been nationally recognized. She is a trained mediator and holds a BA from Kalamazoo College and an MPA/CED from Wayne State University.

Wendy Ventura

Wendy Ventura is the Marketing Director at The Engineering Society of Detroit. In this role, she is responsible for all internal and external marketing initiatives for the Society and its member programs. Wendy has nearly two decades of marketing communications experience and has worked in both corporate and agency environments. She resides in Redford, Mich., with her husband and daughter.

Lynley M. Weston, PE

Lynley M. Weston is an Engineer and Sustainable Construction Manager for Turner Construction Company, a Detroit-based commercial builder in Michigan since 1913. She has helped provide LEED AP staff training, consult on LEED certification-seeking projects, and created construction waste diversion and indoor air quality management implementation plans. Born and raised in the Great Lakes State, she graduated from the University of Michigan with a BS in civil engineering and has recently become a licensed Professional Engineer. She also plays an active role in the ESD Young Engineers Council, a professional development and volunteer group facilitated by The Engineering Society of Detroit.

APPENDIX E

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