AEC Technologies, Trends, and Transformation
CIMdata PLM Leadership Webinar Series—13 October 2016

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Agenda

- Introduction
- Survey Overview
- Performance, Investment, and Technology Usage / Plans
- Potential Benefits, Who Wins, and Sources of Improvement
- Priorities for Improvement, and Obstacles to Change
- CIMdata’s Perspective
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Presenter’s Profile
Your presenter’s professional background

- Ed Martin, Director, AEC & Manufacturing Convergence Consulting Practice
  - Over 36 years of PLM and manufacturing industry experience in the disciplines of product development, manufacturing automation, lean manufacturing, and systems engineering. Before joining CIMdata, Sr. Business Line Manager for Autodesk, Product Line Manager for Delphi Corporation, and Product Engineer at General Motors. Has held management positions in the manufacturing industry and PLM software and services industry, including responsibility for strategic planning, product management, manufacturing strategy, product and industry marketing, and strategic business development. He has driven the development of new solutions and championed the adoption of new technologies ranging from 3D laser scanning to configure/quote solutions and 3D layout.

Our Mission...
Strategic management consulting for competitive advantage in global markets

CIMdata is the leading independent global strategic management consulting and research authority focused exclusively on the PLM market.

We are dedicated to maximizing our clients’ ability to design and deliver innovative products and services through the application of PLM.
The AEC & Manufacturing Convergence Practice serves manufacturers, AEC & EPC services firms, owners / operators and solution providers who are interested in capitalizing on the opportunities for information and workflow convergence.

**Strategic Focus**

Bridge the flow of information and integrate processes across:

- Manufacturing, and
- Facility and infrastructure:
  - Design & engineering
  - Construction
  - Operations & maintenance
  - Decommissioning and recommissioning

**Customer Benefits**

- Develop new business models and opportunities
- Reduce waste from project proposal through commissioning
- Reduce budget and timeline contingencies
- Improve quality and compliance
- Improve efficiency and effectiveness of operations and maintenance
- Improve project lifecycle economics

**Our Services...**

Creating, disseminating, and applying our intellectual capital

**Research**
- Market research & analysis
- Technology research & analysis
- Reports & publications
- Market news
- Member services...

**Education**
- Executive seminars
- PLM Certificate Programs
- Technology seminars
- IFI conferences & workshops
- Best practices training...

**Consulting**
- Strategy & vision
- Needs assessment
- Solution evaluation
- Best practices
- Quality assurance
- Program management
- Market planning...

Delivering strategic advice and counsel through a comprehensive, integrated set of research, education, and consulting services.
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PLM Transformation
Services for Industrial Organizations—improving your PLM-related processes

CIMdata’s PLM consulting methodology—transforming your business for a competitive advantage!
A comprehensive set of services tailored to fit your specific needs...

Our PLM Transformation Clients...
A sampling of CIMdata’s international industrial clients (1 of 2)
Our PLM Transformation Clients...
A sampling of CIMdata’s international industrial clients (2 of 2)

Questions?
Please use the GoToMeeting chat panel

- We’re hoping that the anonymity of the chat window might help participants ask more questions
- If you want to ask a question on the record, we’ll certainly let everyone know you’re asking
- The most important thing is interaction – let us hear from you on the call
A Growing Productivity Gap

Construction productivity growth is not keeping up with manufacturing

Productivity per Employee (US, 1993-2010)

Construction vs Manufacturing

Chart created by CIMdata based upon data from US Bureau of Labor Statistics and National Bureau of Economic Analysis, normalized 1993 = 100%
CIMdata AEC Survey Demographics

- 84 responses included in analysis
- Evenly split across company sizes
  - 20% ± 5% in each size “bin” (1–20, 21–100, 101–500, 501–2000, 2000+)
- 73% of survey respondents are executives, managers, architects, or engineers
- 64% of companies based in North America
  - About 40% of companies get at least 10% of revenue from both Europe & Asia
- Most respondents work on larger scale projects
  - Commercial facilities, Industrial facilities, Process & power, and Public facilities were top 4 project categories

Key Takeaways

- Better performance vs competition is correlated with growth in IT budget and higher adoption of advanced technologies
- Most respondents see significant savings potential (10% or more) for both design/construction and operations/maintenance
- Building products manufacturers, AE firms, general contractors, and owners/operators all stand to benefit
- Most improvement will come via reducing changes and project risk
- Collaboration, change management, and interoperability are priorities
- Main challenges are technology interoperability, lack of owner understanding, and “incrementalism”
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Self-Reported Performance

58% of respondents reported that they are outperforming competitors

Q16: Considering the overall performance of your organization as compared to your competition, how would you rank your performance, including improvement in performance over time?

- Lagging (significantly underperforming the competition)
- Slightly Underperforming (keeping pace with peers, lagging the best)
- Slightly Overperforming (gaining on peers, keeping pace with the best)
- Leading (we are gaining on most competitors)

n=84

The text continues...
Q16) Considering the overall performance of your organization as compared to your competition, how would you rank your business performance, including improvement in performance over time?

Q17) Looking back at the past three years, what changes have occurred for your information technology and related budget (e.g., technology consulting, training)?

Performance vs Investment

Increased IT investment over past 3 years correlates to improved performance

<table>
<thead>
<tr>
<th>Performance vs Competition</th>
<th>Decreased Spend</th>
<th>Same Spend</th>
<th>Increased Spend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overperforming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underperforming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagging</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Size of bubble proportional to number of responses

Past 3 Years Change in IT and Related Budget

Q18) Considering the overall performance of your organization as compared to your competition, how would you rank your business performance, including improvement in performance over time?

Q19) Looking back at the past three years, what changes have occurred for your information technology and related budget (e.g., technology consulting, training)?

Investment Priorities

High performers are more likely to prioritize quality and skills development

<table>
<thead>
<tr>
<th>Quality</th>
<th>Cost Savings</th>
<th>Skills Dev</th>
<th>Capabilities</th>
<th>Bus Dev</th>
<th>Compliance</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Respondents</td>
<td>High Performers</td>
<td>Low Performers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Respondents could select multiple answers

Q15) Thinking about your organization, what business outcomes are typically targeted for investments in technology, training and process improvement?
Q19) Which of the following technologies and techniques do you use TODAY, and which do you expect to BEGIN using within the next three years?

High performers are much more likely to currently use a range of technologies.

Performance vs Technology Usage:
Current usage of more technologies is correlated with better performance.

n=65
min
max
mean
1
2
3
4
5
6
7
8
9
10
11
Lagging
Underperforming
Overperforming
Leading

Note: Respondents could select multiple answers.
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Technology Usage (Plan to Use Next 3 Years)

High performers are looking ahead—low performers are trying to catch up

Q19) Which of the following technologies and techniques do you use TODAY, and which do you expect to BEGIN using within the next three years?

Note: Respondents could select multiple answers

All Respondents
High Performers
Low Performers

Artificial Intel
AR/VR
PLM
IoT
Additive Standards
DfMA
MBE
BIM
Reality Capture
VDC

n=78 All
n=45 High
n=33 Low

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Q10) In your experience, how much of the design and construction cost of a typical facility project (all costs prior to handover) could be saved by eliminating inefficiencies in current processes for design, procurement, and delivery?

Q11) In your experience, how much of the operational lifecycle cost of a typical facility project (operations, maintenance, and decommissioning) could be saved through smarter design and construction, and from better handover information delivery?

Who Can Benefit from Process Improvement?

Benefits will flow to design, fabrication, construction, and operations

Q12) Which types of organizations stand to capture the largest benefit from better integration across manufacturing, design, construction, and the operational lifecycle of facilities?

Note: Respondents could select multiple answers
Where Will Benefits Come From?

Most of the benefit is expected from reducing risk, changes, and estimating errors.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced Risk</td>
<td>60%</td>
</tr>
<tr>
<td>Fewer Changes</td>
<td>50%</td>
</tr>
<tr>
<td>Accurate Estimating</td>
<td>40%</td>
</tr>
<tr>
<td>Facility Performance</td>
<td>30%</td>
</tr>
<tr>
<td>Maintenance Efficiency</td>
<td>20%</td>
</tr>
<tr>
<td>Prefab Modules</td>
<td>10%</td>
</tr>
<tr>
<td>Improved Compliance</td>
<td>5%</td>
</tr>
<tr>
<td>New Services Revenue</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>0%</td>
</tr>
</tbody>
</table>

n=82

Note: Respondents could select multiple answers.

Q14: In your opinion, which areas offer the largest business opportunity for your organization?

Project Phases & Improvement Potential

Opportunities exist in engineering design, specification, estimating, and planning.

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Improvement Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr Design</td>
<td>70%</td>
</tr>
<tr>
<td>Clash/Mockup</td>
<td>60%</td>
</tr>
<tr>
<td>Product Specif</td>
<td>50%</td>
</tr>
<tr>
<td>Estimating</td>
<td>40%</td>
</tr>
<tr>
<td>Const Planning</td>
<td>30%</td>
</tr>
<tr>
<td>Procurement</td>
<td>20%</td>
</tr>
<tr>
<td>Prefabrication</td>
<td>10%</td>
</tr>
<tr>
<td>Requirements</td>
<td>5%</td>
</tr>
<tr>
<td>Performance Sim</td>
<td>1%</td>
</tr>
<tr>
<td>Const Detail</td>
<td>0%</td>
</tr>
<tr>
<td>Arch Design</td>
<td>0%</td>
</tr>
<tr>
<td>Asset Mgmt</td>
<td>0%</td>
</tr>
<tr>
<td>Proposal</td>
<td>0%</td>
</tr>
<tr>
<td>Handover</td>
<td>0%</td>
</tr>
<tr>
<td>De/Re-Commission</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>0%</td>
</tr>
</tbody>
</table>

n=75

Note: Respondents could select multiple answers.

Q21: Of the following phases of the workflow, which ones offer the largest potential for business improvement? Do not consider the difficulty of change, only whether improving the workflow would provide business benefits.
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Capabilities – Priorities for Improvement

Collaboration, change management, interoperability, documentation are priorities

Q3) Improvement: In which underlying capabilities and processes would yield the largest business benefits?

Note: Respondents could select multiple answers
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**Obstacles to Improvement**

- Interoperability
- Lack of owner understanding
- "Incrementalism" key issues

<table>
<thead>
<tr>
<th>Obstacles</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology solutions not interoperable</td>
<td>40%</td>
</tr>
<tr>
<td>Owners don't know what to ask for</td>
<td>30%</td>
</tr>
<tr>
<td>No single owner can drive change</td>
<td>20%</td>
</tr>
<tr>
<td>Can't justify for any single project</td>
<td>10%</td>
</tr>
<tr>
<td>Legal liabilities and risks</td>
<td>5%</td>
</tr>
<tr>
<td>Technology not mature</td>
<td>5%</td>
</tr>
<tr>
<td>Benefits realized by others</td>
<td>5%</td>
</tr>
<tr>
<td>Small companies can't afford</td>
<td>5%</td>
</tr>
<tr>
<td>Technology too complex</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>5%</td>
</tr>
</tbody>
</table>

n=73

Note: Respondents could select multiple answers

Q26: Which of the following challenges are major factors preventing the investment in time, training, and information technology needed to improve processes and business outcomes?

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Lifecycle Value Gap
Loss of information leads to higher costs, wasted time, and compliance issues

Gaps:
- Incomplete information for manufactured content
- Information integrity losses during design & construction
- Ineffective information integration into operational phase of lifecycle

A Digital Thread for Facilities & Infrastructure
A PLM approach is needed to create a digital thread to support project lifecycles
Opportunities for Improvement

A range of stakeholders can benefit by adopting proven manufacturing techniques

Building Products Manufacturers & Fabricators
- Bid process improvement
- Configuration management
- PLM integration
- Content publishing automation
- Digital manufacturing
- Service lifecycle processes

Architectural & Engineering Services
- Requirements management
- Multi-discipline design integration
- Change management
- Collaboration and security processes
- Systems engineering
- Cloud services integration

Construction Services
- Change management
- Collaboration and security processes
- BIM integration
- Handover package automation
- Cloud services integration

Owners & Operators
- Requirements definition
- Change management
- Predictive maintenance
- IoT integration
- Advanced analytics and machine learning

CIMdata’s Perspective on the Near Future

What the next three to five years will bring (1 of 2)

- Meaningful adoption of standards
  - Standards will mature beyond design data, to support the entire lifecycle

- Construction productivity focus
  - Construction solution providers will embrace BIM, and vice-versa

- Manufacturing technologies and processes will take hold
  - PLM, prefabrication, configuration, automation, lean, and more ...

- Wide adoption of cloud services and integration via Web APIs
  - The advantages are compelling, and we are just hitting the tipping point

- Reality capture will become common practice
  - The technology will penetrate everything from quality assurance to maintenance use cases
CIMdata’s Perspective on the Near Future

What the next three to five years will bring (2 of 2)

- IoT moves from an acronym to an expectation
  - Real-world benefits will be realized using data science combined with IoT
- Security concerns
  - A significant incident will galvanize the industry’s attention
- Artificial Intelligence will gain traction
  - Primary applications will be in the areas of computational design, construction planning optimization, and predictive analytics
- Systems engineering will become the next hot topic
  - Accelerating complexity will force the industry to deal with systems of systems

Special Offer for Attendees

- 2016 AEC Market Overview Report
- This report contains CIMdata’s detailed analysis of the AEC market. The 60 page report contains more than 20 tables and charts and includes:
  - A detailed discussion of trends in the market
  - How AEC solution providers are responding
  - CIMdata’s estimates for the AEC market for CY 2015, with a forecast through 2020
  - Detailed descriptions of the top 16 solution providers
- Regular price $1,795
  - Webinar attendees are eligible for a $500 discount, good through November 13, 2016
  - Contact c.peck@cimdata.com for a discount code
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Contact slide

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**Blog**  
http://www.cimdata.com/en/resources/cimdata-blog

**LinkedIn**  
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Q3) How many people work at your organization?

Demographics: Company Size

Survey respondents are evenly distributed across a range of company sizes

Q3) How many people work at your organization?

Demographics: Respondent Role

73% of survey respondents are executives, managers, architects, or engineers
**Demographics: Company HQ Location**

Survey respondents’ companies are primarily headquartered in the US and Canada.

Q8. Where is your organization headquartered?

- US or Canada: 60%
- Europe: 20%
- Asia-Pacific: 10%
- Africa: 5%
- Latin America: 5%

n=84

**Demographics: Company Project Locations**

Survey respondents’ companies operate globally, but weighted toward NA.

Q9. Where does your organization perform at least 10% of its work in a typical year?

- North America: 80%
- Europe: 70%
- APAC: 50%
- Latin America: 20%
- Middle East: 10%
- Africa: 5%

n=84

Note: Respondents could select multiple answers.
Q3: For what types of projects does your organization perform at least 10% of its work in a typical year?

Note: Respondents could select multiple answers.

Demographics: Project Types

Larger scale facilities along with process and power predominate

- Commercial Facilities
- Industrial Facilities
- Process & Power
- Public Facilities
- Rail, Road, Utility
- Military & Gov't
- Multi-unit Residential
- Other
- Offshore & Marine
- Single Residential

n=84