THE ROAD TO PRODUCTIVITY

Lessons Learned by the Structural Steel Industry

Tom Faraone, PE

Senior Regional Engineer

October 31, 2006

It started with the mills…

TODAY

Today .5 man-hours/ton

1/3 the energy

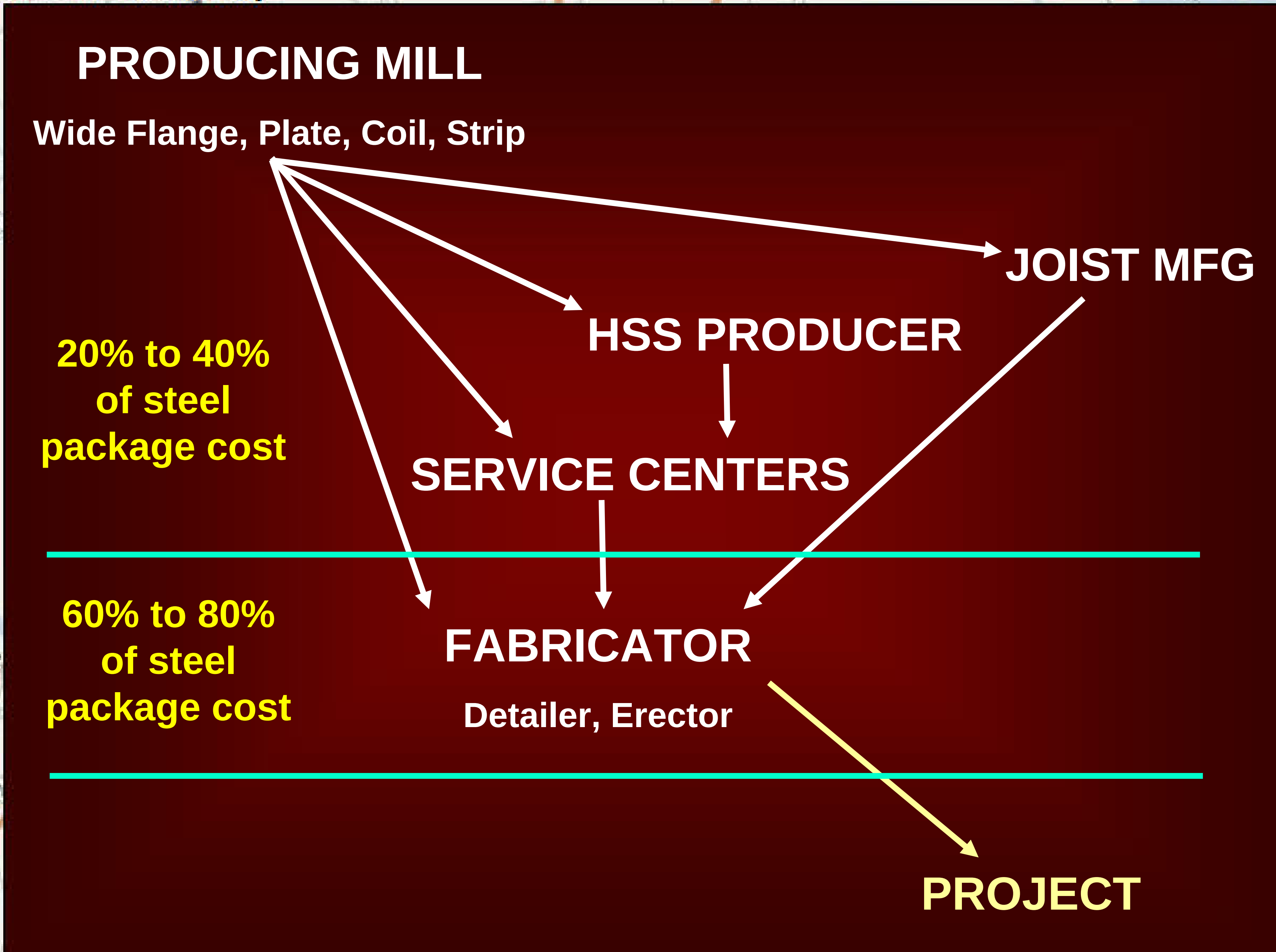
40% higher strength

37% reduction in GHG

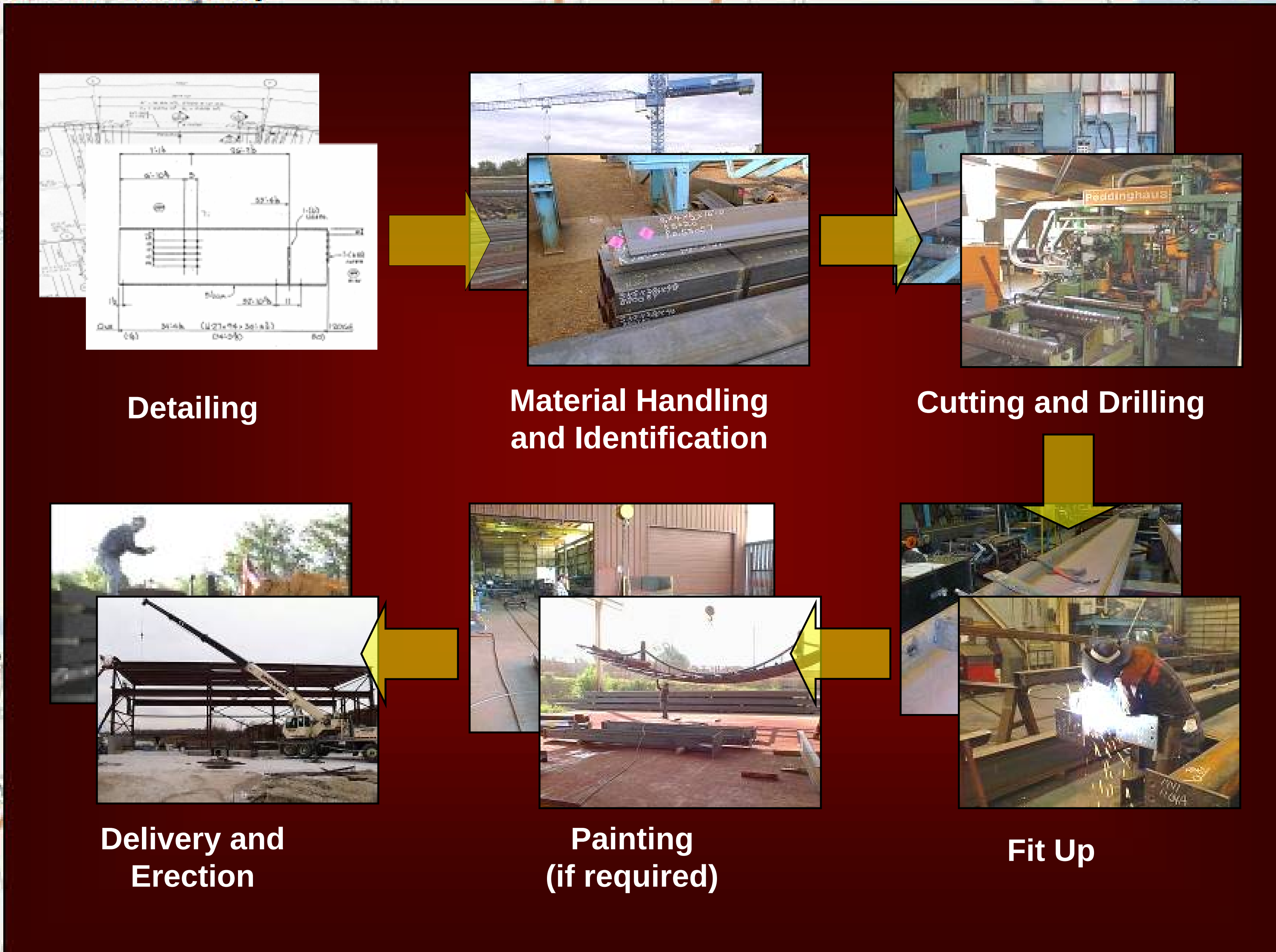
PRODUCTIVITY

1980

12 man-hours/ton

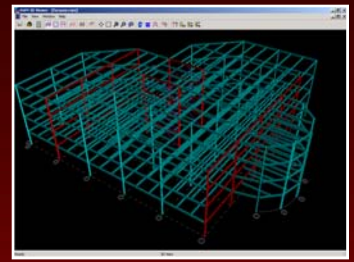

PRODUCING MILL
Wide Flange, Plate, Coil, Strip
JOIST MFG
HSS PRODUCER
20% to 40% of steel package cost
SERVICE CENTERS
60% to 80% of steel package cost
FABRICATOR
Detailer, Erector
PROJECT

A BIM Roadmap

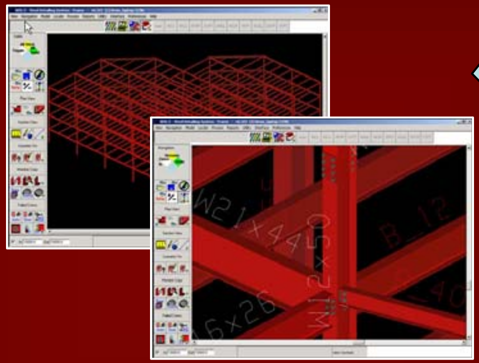


STRUCTURAL FRAMING SYSTEM

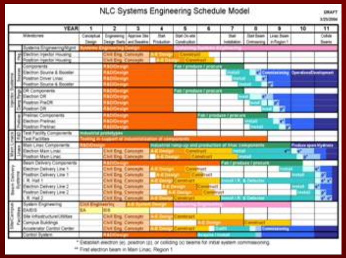
Structural Design



3D Modeling & Detailing



Material Orders and Scheduling



Fabrication

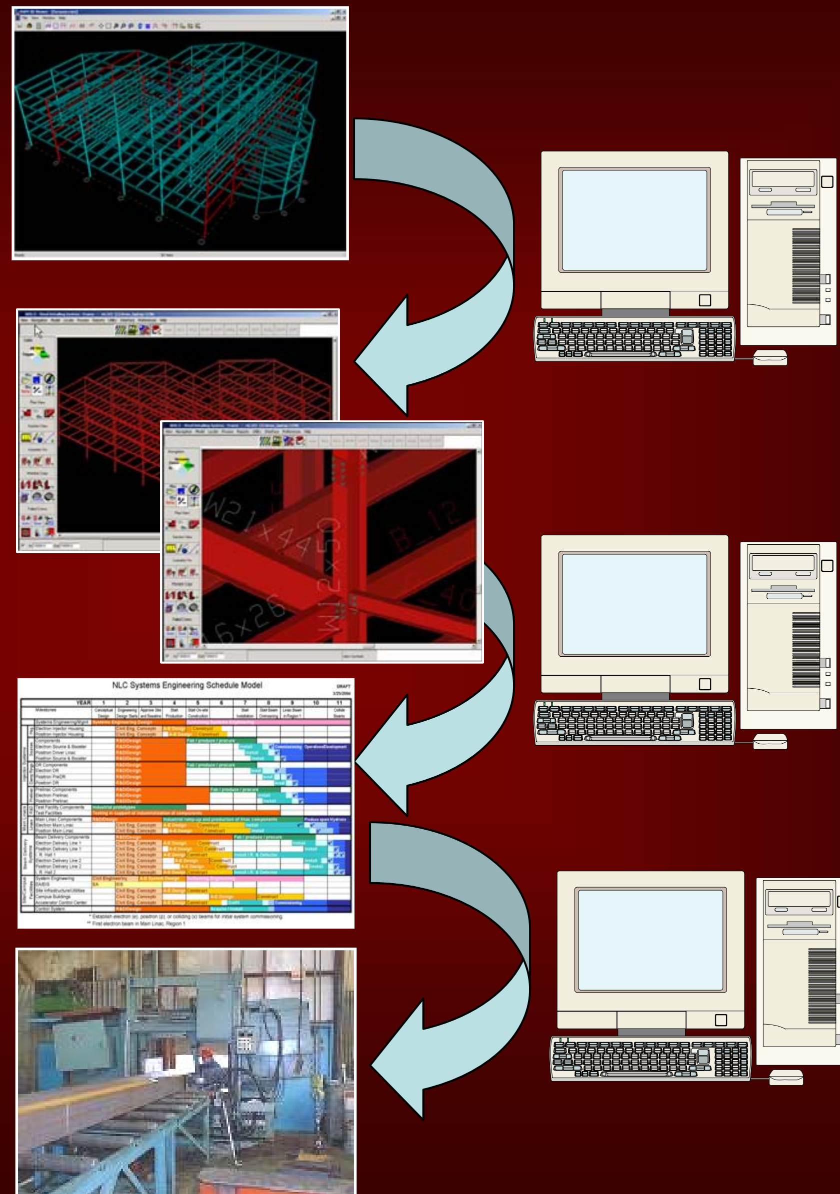
STRUCTURAL FRAMING SYSTEM

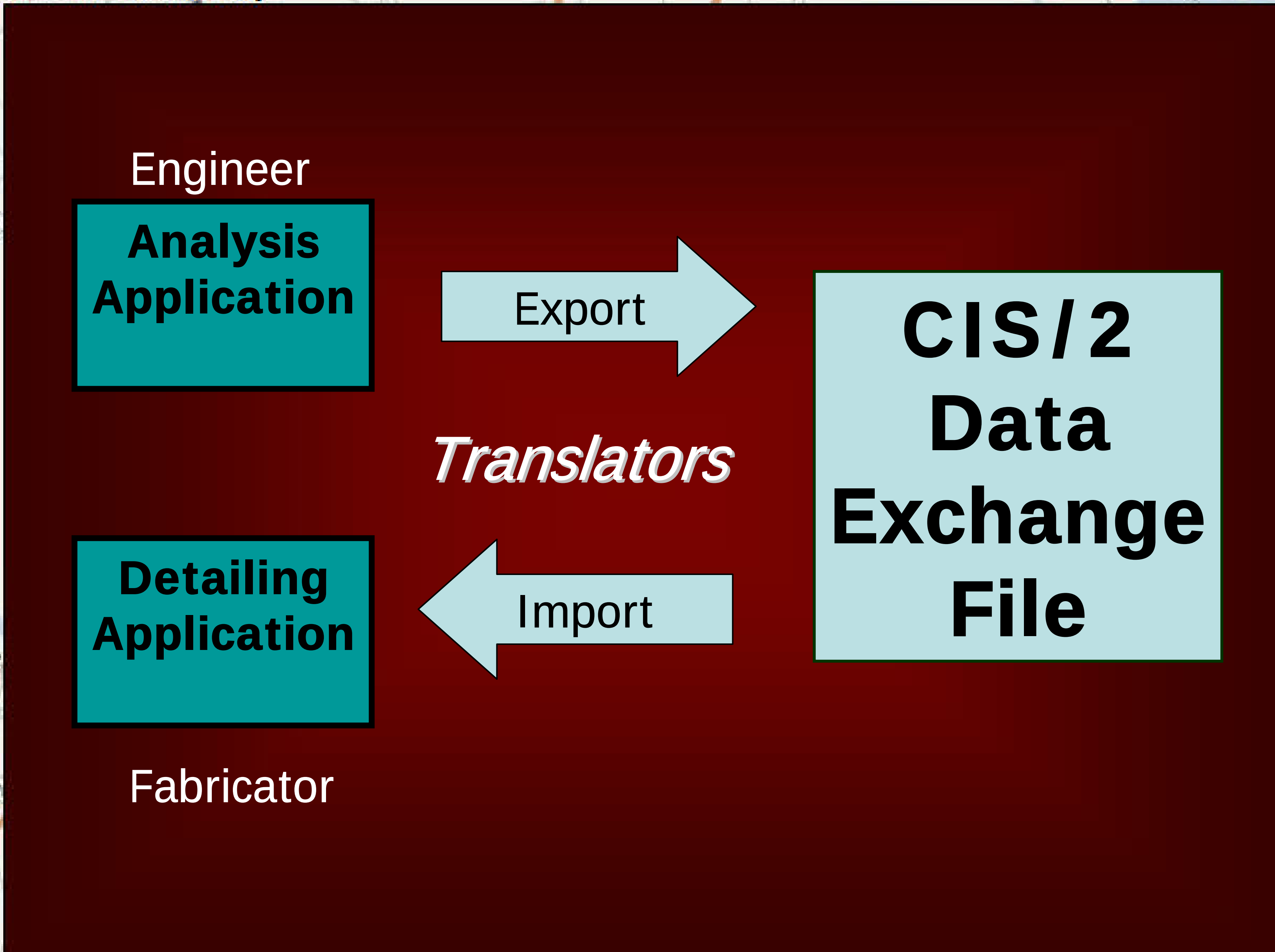
Structural Design

3D Modeling & Detailing

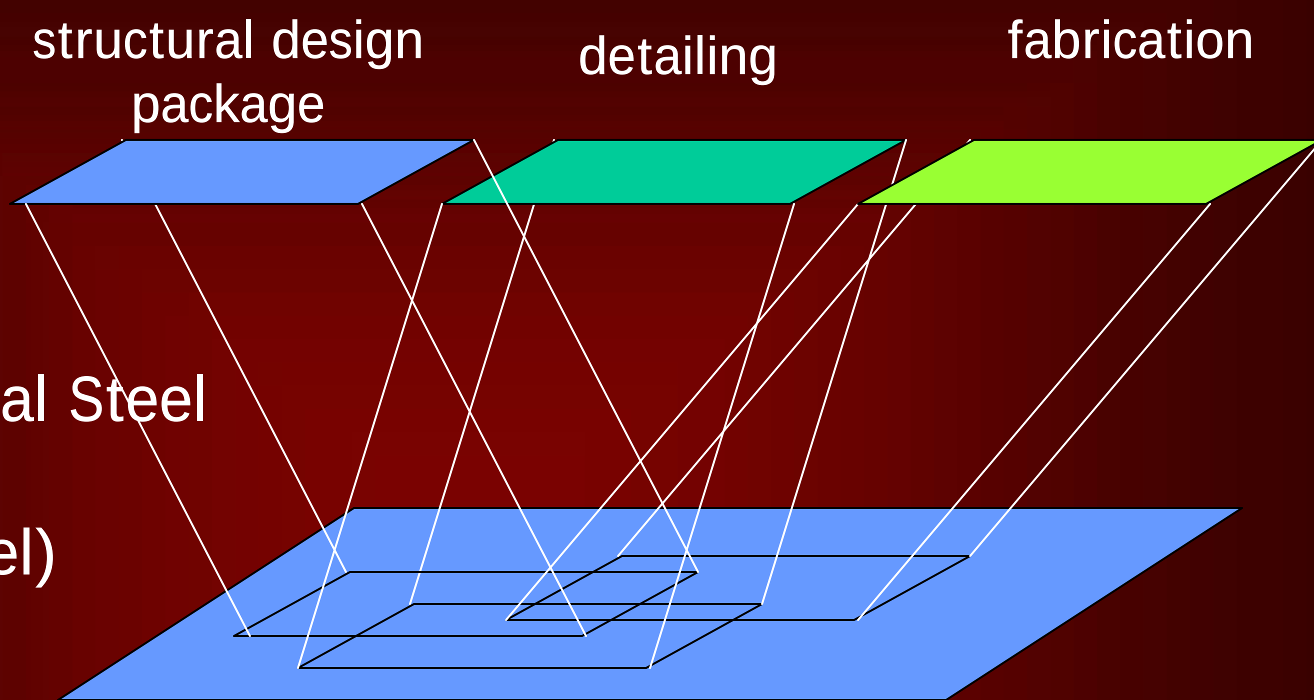
Material Orders and Scheduling

Fabrication




Engineer
Analysis Application
Export
CIS/2 Data Exchange File
Translators
Detailing Application
Import
Fabricator

Example applications



CIS/2 Structural Steel Product Model (Building Model)

CIS/2 integrates all information needed for design, analysis, procurement, fabrication planning, fabrication automation and logistics and erection of structural steel in buildings

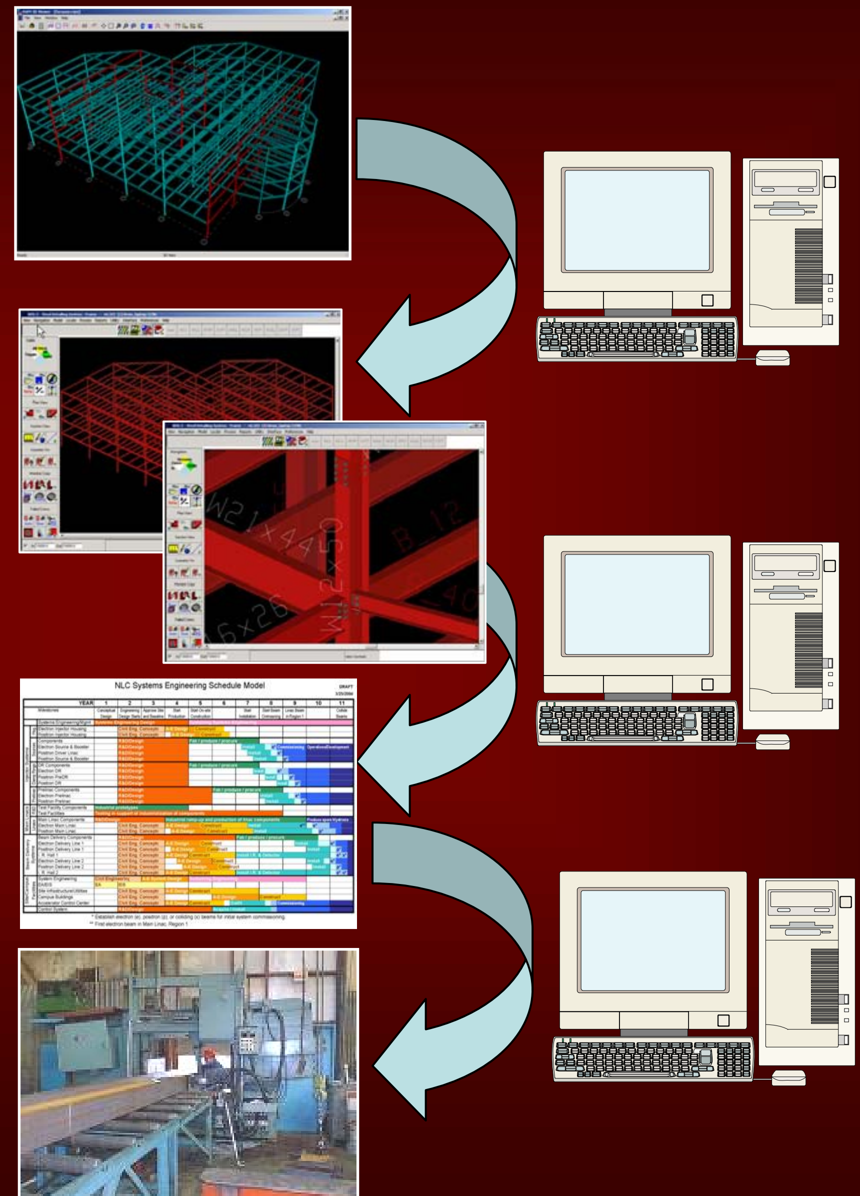
STRUCTURAL FRAMING SYSTEM

Structural Design

3D Modeling & Detailing

Material Orders and Scheduling

Fabrication



Casino of the Sun, Tucson, AZ

425 tons

Design Complete 3/7

Erection Begun 3/26

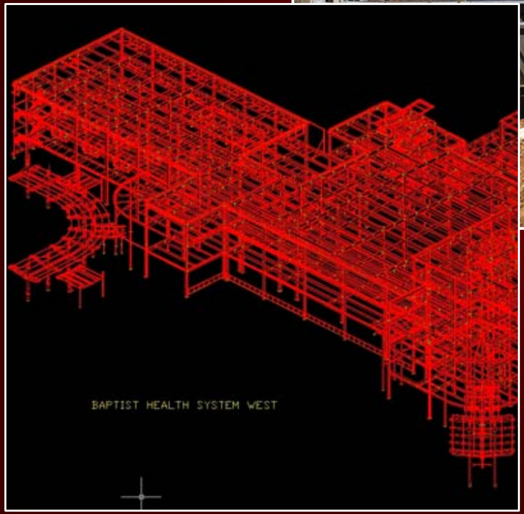
Fabrication Started 3/14

Glenn Oaks Schools, Queens, NY

3500 tons

- Significantly reduced detailing errors
- Reduce review time for shop drawings
- Increased engineer confidence that what was designed was what was built
- Significant schedule reduction

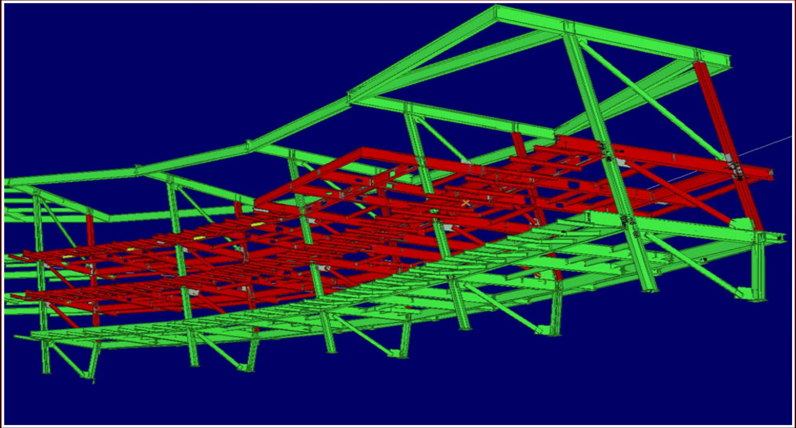
Baptist West Hospital, Knoxville, TN



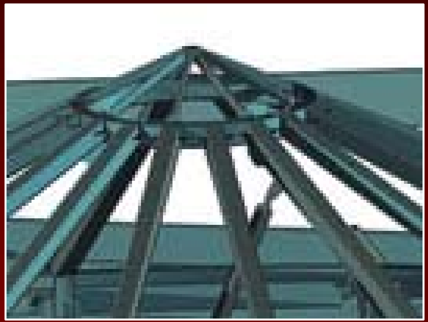
Traditional Schedule	**18 weeks**
Actual Schedule	**11 weeks**
Time Saved	**7 weeks**

Soldier Field, Chicago, IL

One Season!



Mt Tahoma High School, Tacoma, WA



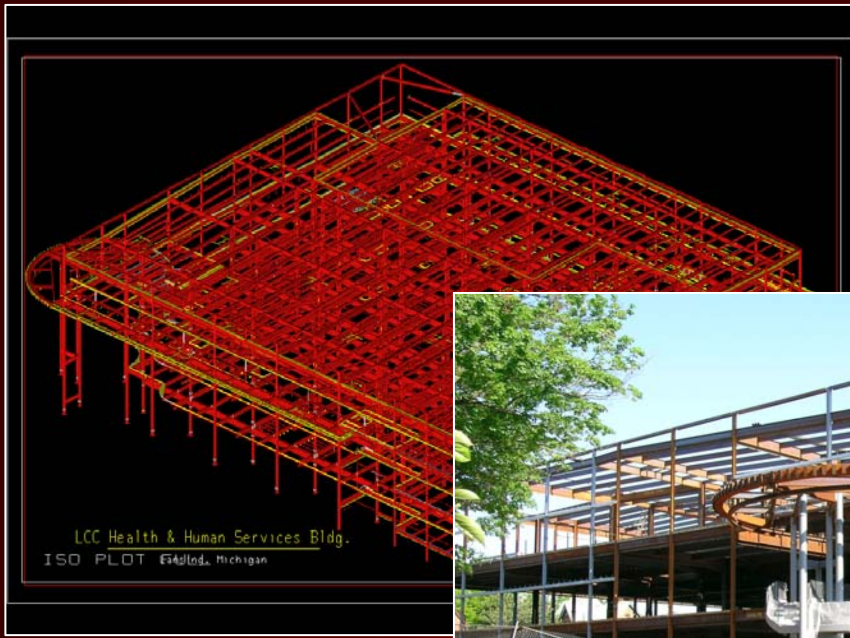
1900 TONS

Saved 3 months

Only 13 RFIs on 3,035 assemblies

Only 4 of 15,256 bolts not aligned

Lansing Community College

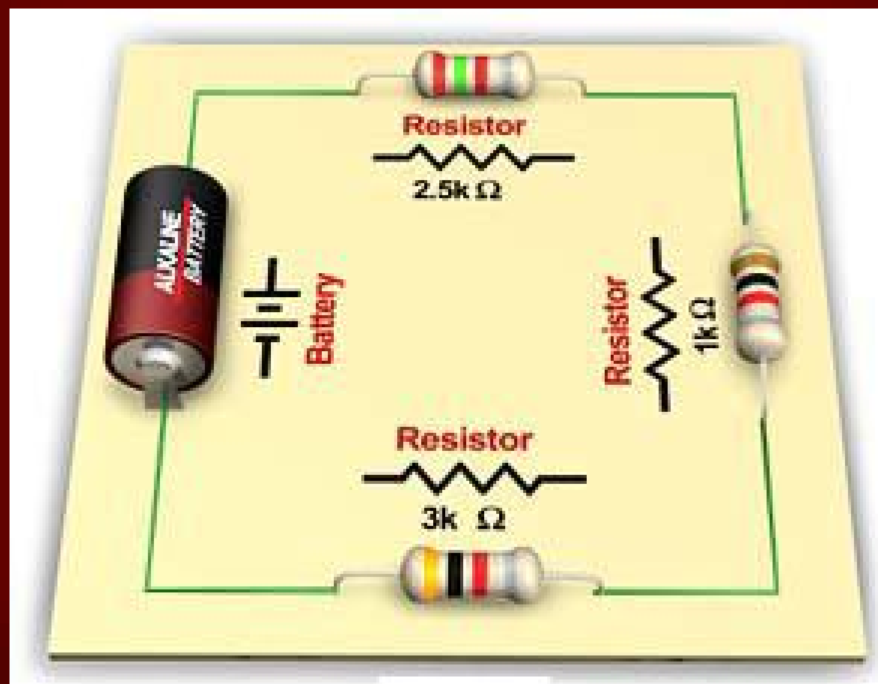


Saved $2.35/SF
(8% of steel package)

Why not more?

Structural Engineers

Owners



Detailers

Fabricators

RESISTANCES:

Additional Cost

Model Discipline

Level of Model Detail

Release of Proprietary Information

Model Ownership

Dimensional Definitions

2-D Drawings Required for Permitting

Acceptance as Contract Documents

Contractual Relationship Definitions

Model Quality

Design-Bid-Build Process

Staffing Responsibilities

Multiple Software Platforms

I Don’t Want to be First

AISC 303-05

Code of Standard Practice for Steel Buildings and Bridges

March 18, 2005

Supersedes the March 7, 2000 AISC *Code of Standard Practice for Steel Buildings and Bridges* and all previous versions.

Prepared by the American Institute of Steel Construction, Inc. under the direction of the AISC Committee on the Code of Standard Practice and issued by the AISC Board of Directors.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.
One East Wacker Drive, Suite 3100, Chicago, Illinois 60601-2000

16.3-65

DIGITAL BUILDING PRODUCT MODELS

n this Appendix shall apply when the contract documents indicate that a l digital building product model replaces contract drawings and is to be nary means of designing, representing, and exchanging structural steel ect. When this is the case, all references to the Design Drawings in this ead apply to the Design Model, and all references to the Shop and gs in the Code shall instead apply to the Manufacturing Model. The roduct Model shall be used as the building product model for structural

primary means of project communication reverts from a model-based per-based system, the requirements in this Code other than in this pply.

ogy permits the transfer of three-dimensional digital building product ng the design and construction teams for a project. Over the last several and fabricators have used CIS/2 as a standard format in the exchange of models representing the steel structure. This Appendix facilitates the ology in the design and construction of steel structures, and eliminates n of this Code that might be construed to prohibit or inhibit the use of While the technology is new and there is no long-established standard of intent in this Appendix to provide guidance for its use.

GLOSSARY

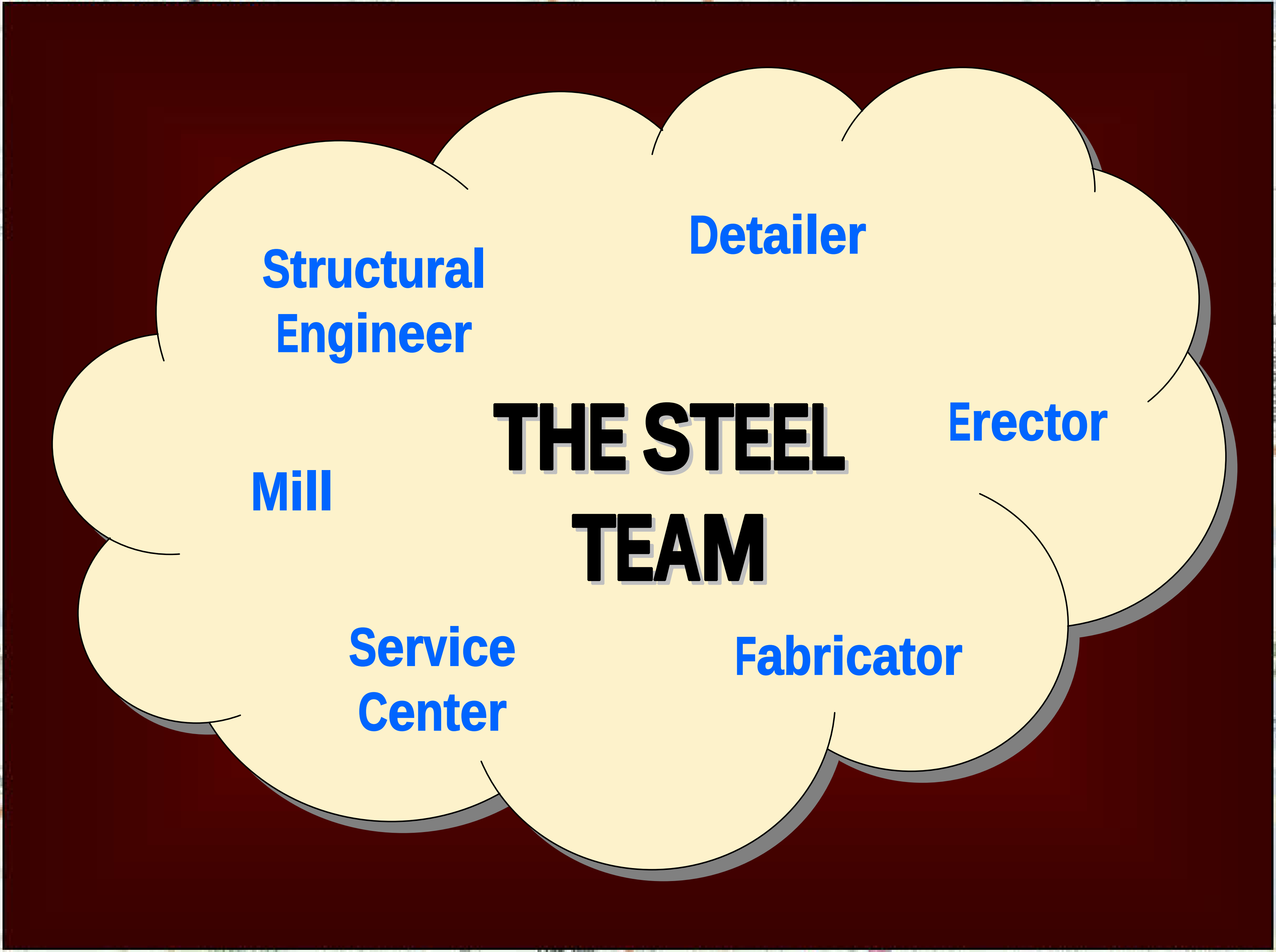
g definitions to the Glossary:

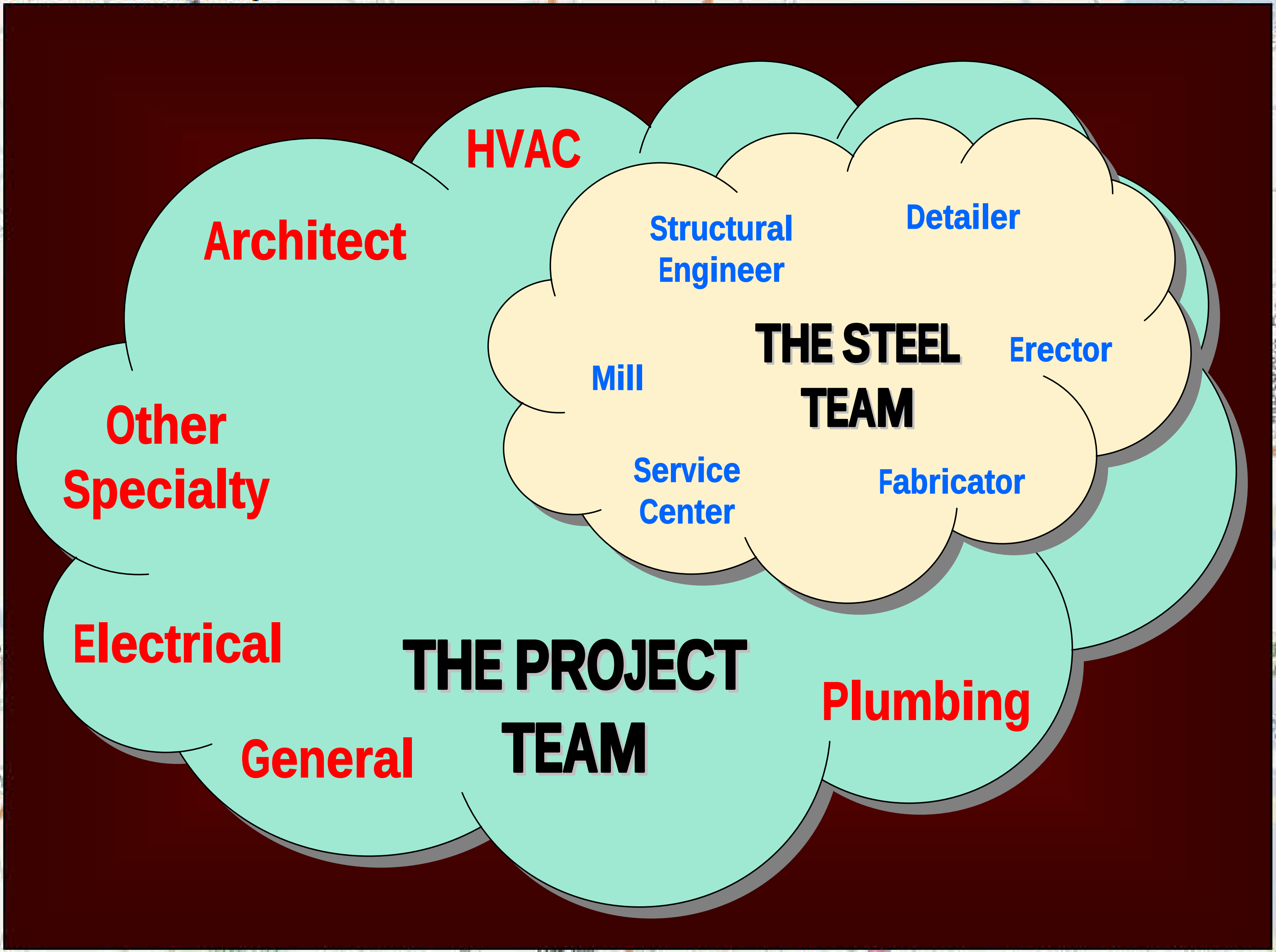
t Model. A digital information structure of the objects making up a pturing the form, function, behavior and relations of the parts and within one or more building systems. A building product model can be l in multiple ways, including as an ASCII file or as a database. The data el is created, manipulated, evaluated, reviewed and presented using sed design, engineering, and manufacturing applications. Traditional onal drawings may be one of many reports generated by the building del (see Eastman, Charles M.: Building Product Models: Computer ts Supporting Design and Construction; 1999 by CRC Press).

CIS/2 (CIMSteel Integration Standards/Version 2). The specification providing the building product model for structural steel and format for electronic data interchange (EDI) among software applications dealing with steel design, analysis, and manufacturing.

Logical Product Model (LPM). The CIS/2 building product model, which supports the engineering of low-, medium- and high-rise construction, in domestic, commercial

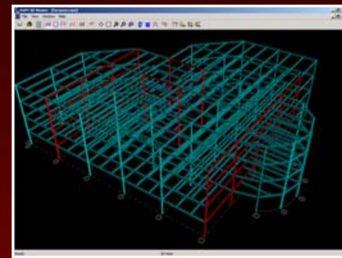
Code of Standard Practice for Steel Buildings and Bridges, March 18, 2005
AMERICAN INSTITUTE OF STEEL CONSTRUCTION

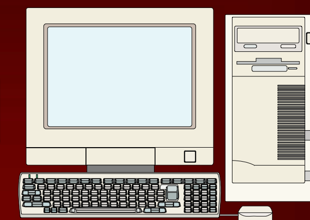

Structural
Engineer
Detailer
THE STEEL
TEAM
Erector
Mill
Service
Center
Fabricator


HVAC
Architect
Other Specialty
Electrical
General
THE PROJECT TEAM
Plumbing
Structural Engineer
Detailer
Mill
THE STEEL TEAM
Erector
Service Center
Fabricator

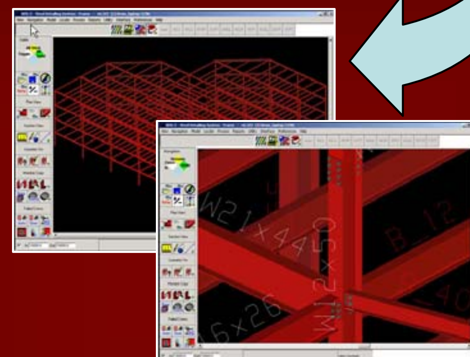
STRUCTURAL FRAMING SYSTEM

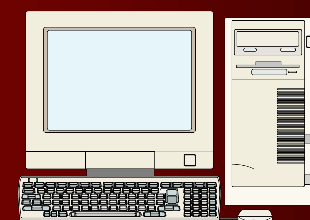
Structural Design



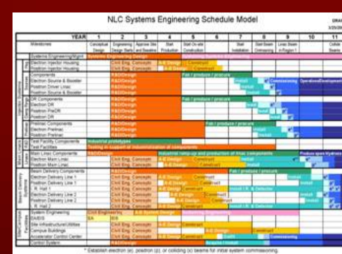


3D Modeling & Detailing





Material Orders and Scheduling



Fabrication

Design-Build

$2.345 Million

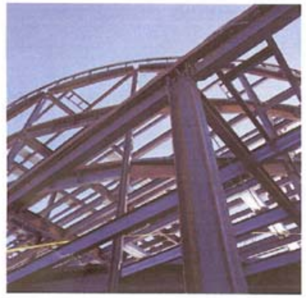
$16.28/SF

772 tons

$3037.57/ton

ruby+associates

St. Vincent Medical Center
Heart Pavilion – Toledo, Ohio



As partners in the Design/Build (D/B) delivery of the structural and steel component of this project, Ruby+Associates worked closely with Art Iron (Toledo, OH) to design and construct this four-story, 144,000 square foot facility for the St. Vincent Mercy medical campus. Using Constructability concepts and the D/B delivery method, the structural project team compressed the steel schedule for the project, expediting an aggressive project completion target.

Art Iron and Ruby adopted electronic document sharing to seamlessly join the steel design and fabrication elements of the project. Ruby performed the engineering analyses and created the structural model that guided the steel fabrication. Art Iron provided input into the model and design throughout the process. Many economies were designed into the structure throughout this initial collaboration. When the model was completed, Ruby sent the files electronically to Art Iron, an Advance Bill of Materials for ordering raw steel was generated, and shop drawings were created. The review process was also performed electronically. The schedule was significantly reduced by using the design model to create the 3D detailing model. This approach facilitated "real time" collaboration on the structural design and shop fabrication drawing development.

DESIGN / BUILD METHOD

Design Time (10) weeks
Bid / Estimate Time (0) weeks
Award Time (0) weeks
Prepare ABM (1) day
Order Material (1) week
Detail Shop Drawings (6) weeks
Approval Review Time (1) week
Incorporate Design Changes (1) week
Fabricate Steel (8) weeks
Erect Steel (8) weeks

Total Duration - 35 weeks & 1 day

Real Time Schedule Savings – 17 weeks

DOLLARS & SENSE:
$2,345,000.00
$16.28 / SF
772 Tons
$3,037.57 / Ton

DESIGN / BID / BUILD METHOD

Design Time (10) weeks
Bid / Estimate Time (4) weeks
Award Time (1) week
Prepare ABM (3) weeks
Order Material (1) week
Detail Shop Drawings (8) weeks
Approval Review Time (3) weeks
Incorporate Design Changes (4) weeks
Fabricate Steel (9) weeks
Erect Steel (9) weeks

Total Duration – 52 weeks

DOLLARS & SENSE:
$2,800,000.00
$19.44 / SF
910 Tons
$3,076.92 / Ton

30445 Northwestern Highway Suite 310 Farmington Hills, MI 48334 T: 248.865.8855 F: 248.865.9449 www.rubyusa.com

Design-Bid-Build

$2.8 Million

$19.44/SF

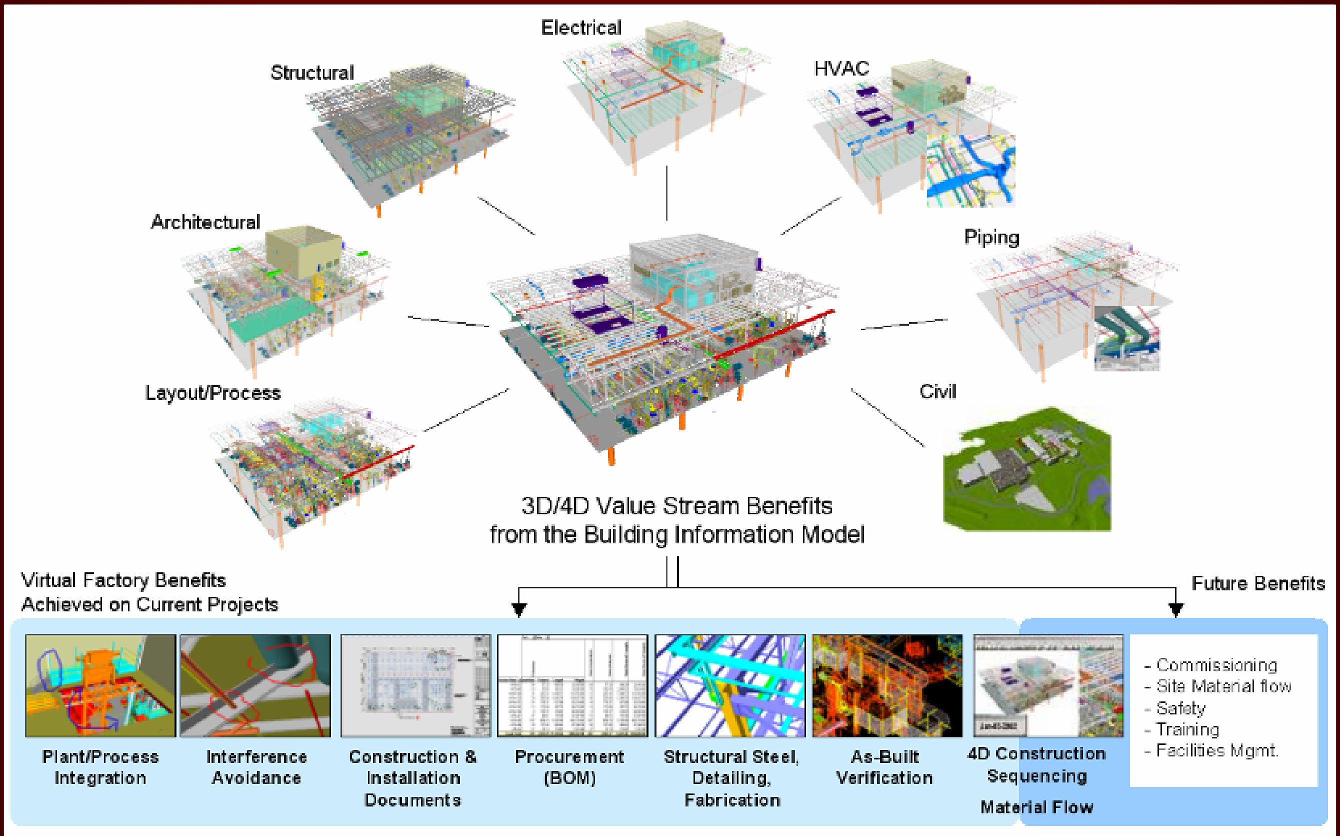
910 tons

$3078.82/ton

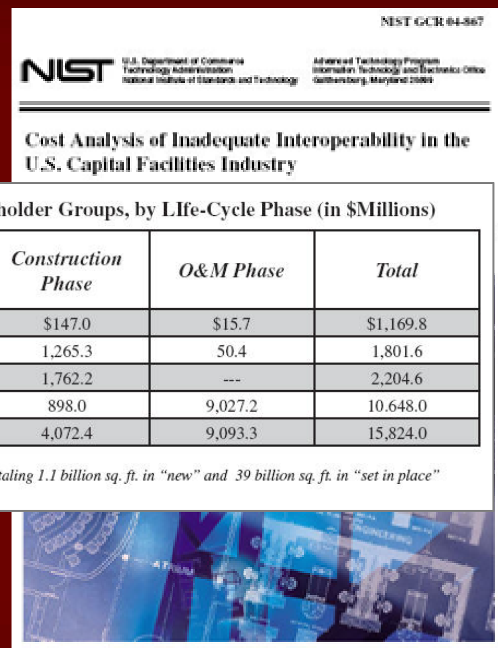
FOTA

First Organize, then Automate

And then came BIM…



And then came BIM…


NIST GCR 04-867

NIST

U.S. Department of Commerce
Technology Administration
National Institute of Standards and Technology

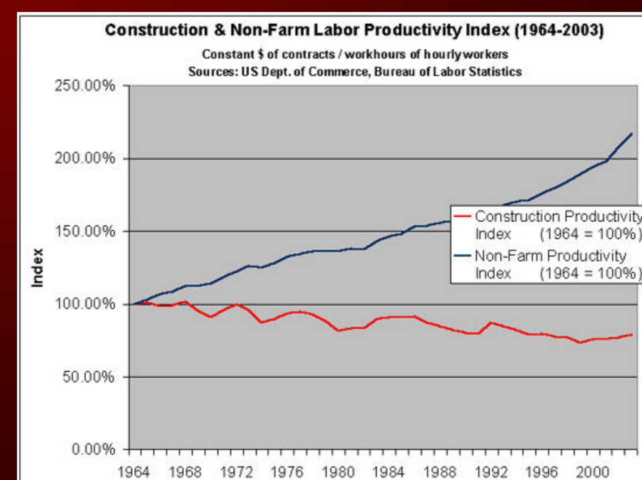
Advanced Technology Program
Information Technology and Electronics Office
Gaithersburg, Maryland 20899

Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry

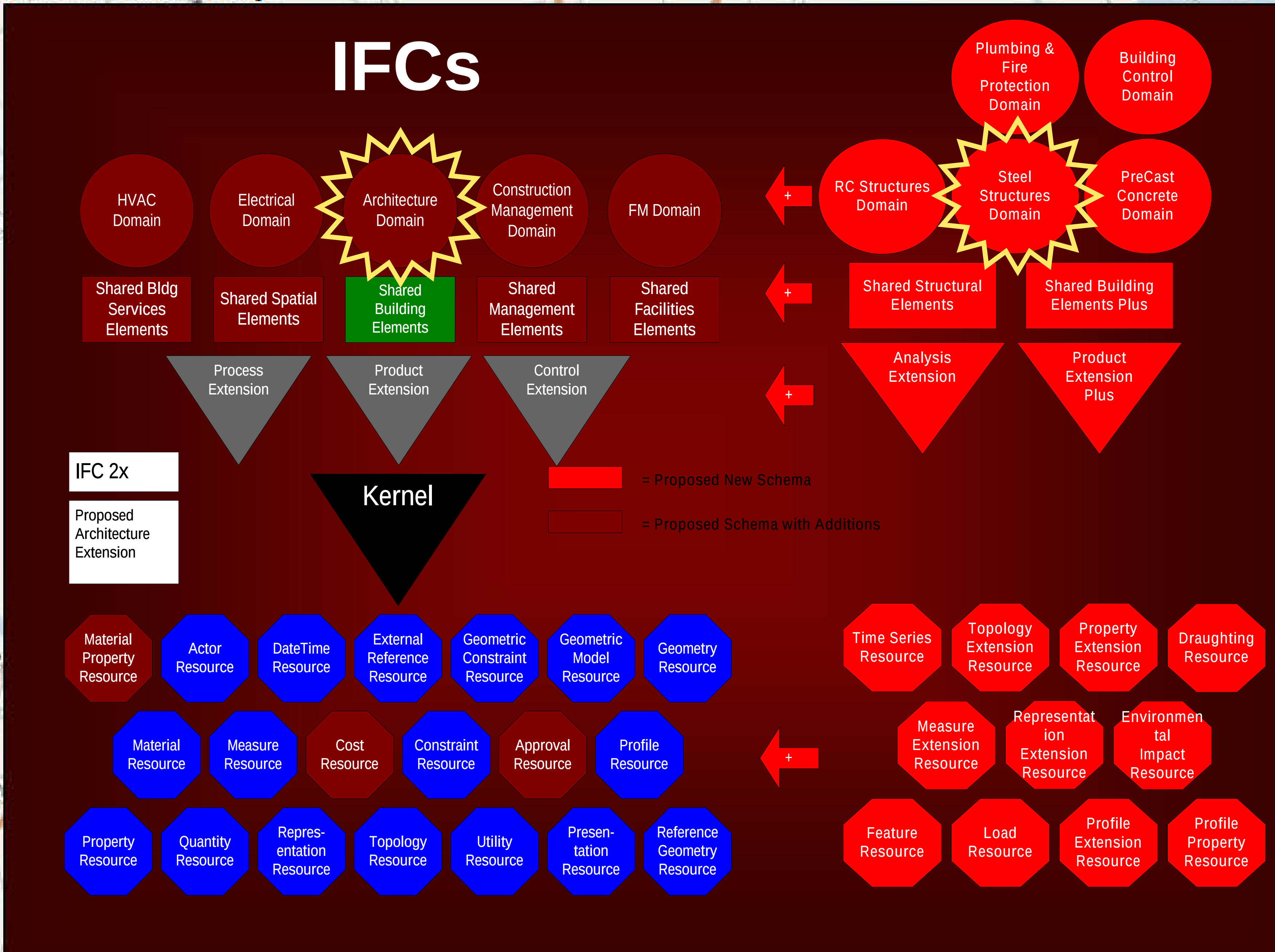
Costs of Inadequate Interoperability by Stakeholder Groups, by LIfe-Cycle Phase (in $Millions)

Stakeholder Group	*Planning, Engineering, Design Phase*	*Construction Phase*	*O&M Phase*	*Total*
Architects and Engineers	$1,007.2	$147.0	$15.7	$1,169.8
General Contractors	485.9	1,265.3	50.4	1,801.6
Specialty Contractors/Suppliers	442.4	1,762.2	---	2,204.6
Owners and Operators	722.8	898.0	9,027.2	10.648.0
All Stakeholders (Total)	2,658.3	4,072.4	9,093.3	15,824.0

Source: *Table 6.1 NIST*
Note: *Includes commercial, institutional, and industrial buildings totaling 1.1 billion sq. ft. in "new" and 39 billion sq. ft. in "set in place" construction.*

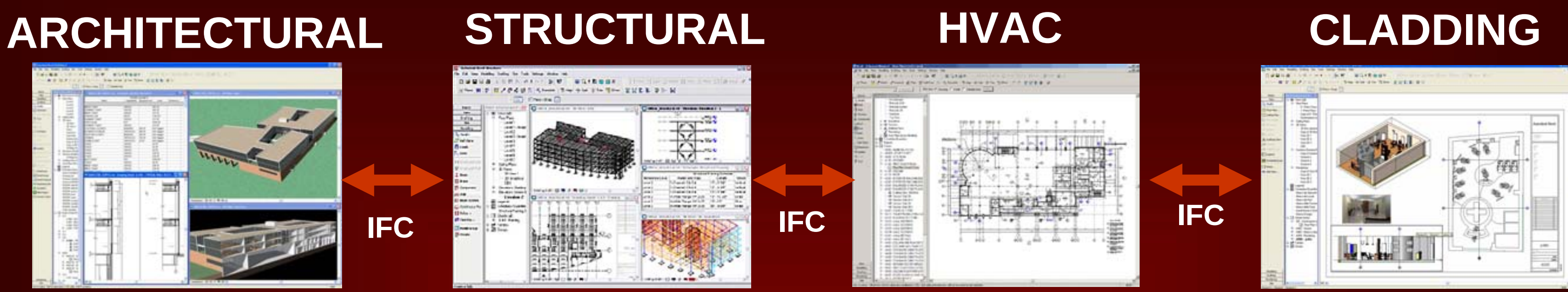


A BIM Roadmap



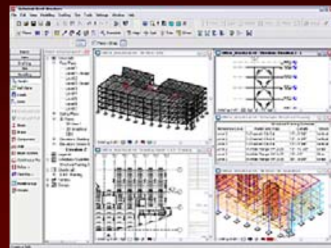
Lessons Learned from the Structural Steel Industry

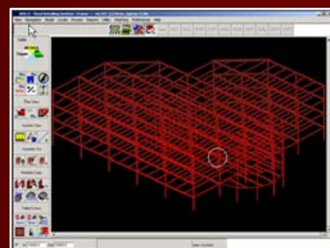
A BIM Roadmap



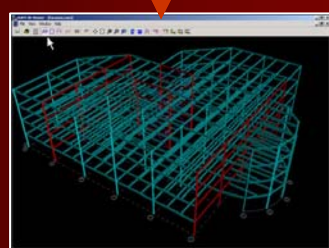
Building Information Modeling horizontally integrates all building systems into a single, consistent design model allowing coordination of components and elimination of interferences.

STRUCTURAL





CIS/2

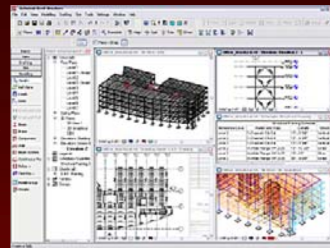


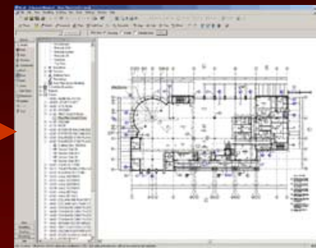
CIS/2

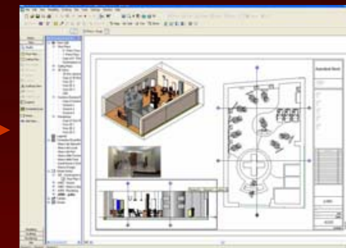
The structural steel industry has taken the lead in vertically integrating the design and fabrication process for structural steel through interoperable programs utilizing the CIS/2 protocol.

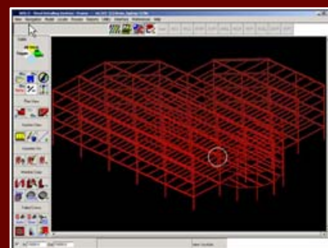
A BIM Roadmap

ARCHITECTURAL **STRUCTURAL** **HVAC** **CLADDING**

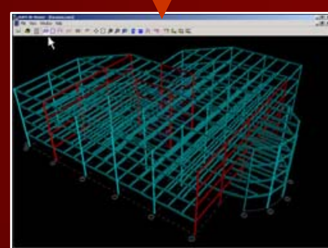








CIS/2



CIS/2

Building Information Modeling information integrates directly with the vertical structural steel process allowing significant productivity increases by combining the advantages of both horizontal and vertical integration within the context of off site fabrication.

INCREASED PRODUCTIVITY EQUALS

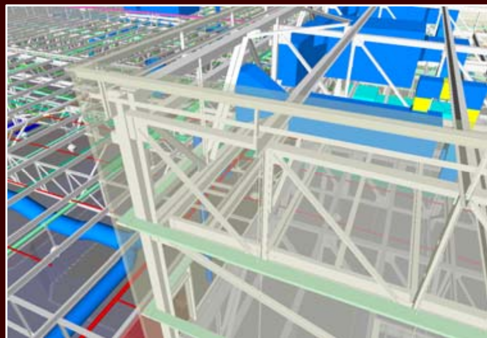
Greater Value

Lower Costs

Accelerated Schedules

Safer Construction

Application of Lean Construction Best Practices




THE CONSTRUCTION WEEKLY October 10, 2005 • enr.com The McGraw-Hill Companies

ENR
Engineering News-Record

Visions No easy path for post-Katrina planning

Energized Devastation opens door for new power grid

Next Wave U.S. awards $2.5 billion in new embassy contracts

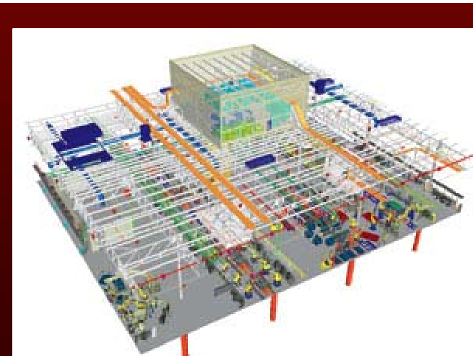
Virtual Building

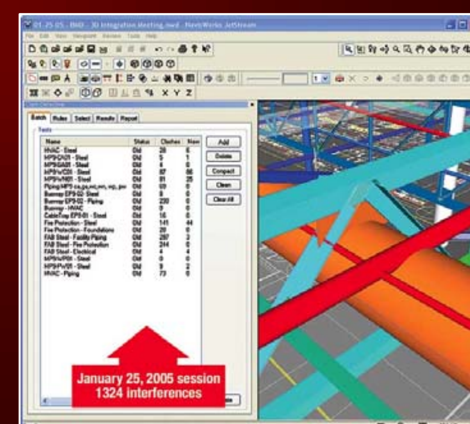
General Motors' design-build team perfects a digital design, then locks it and builds without changes. The result? Faster, better, cheaper, safer--and smiles all around.

McGraw_Hill CONSTRUCTION

General Motors

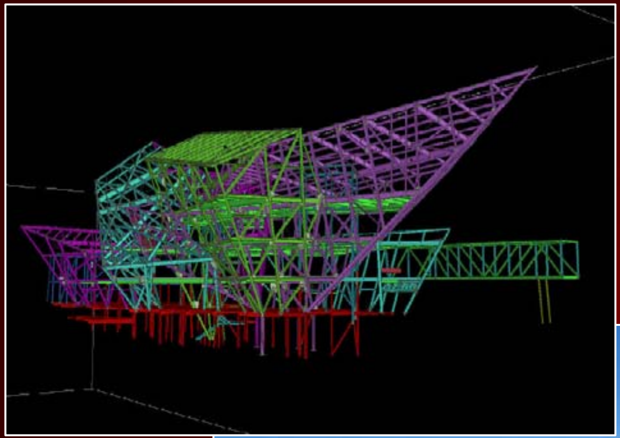
Flint, Michigan





Denver Art Museum

ENR



"…brought in on time and on budget"

"…no claims pending or expected"

BUILDING INFORMATION MODELING:

- "…prevented 1,200 collisions of steel elements"
- "…sped steel erection to the finish line three months early"
- "…gave nearly $400,000 back to the owner"

Wayne L Morse U.S. Courthouse
Eugene, OR

"Fastest GSA project ever."

"Change orders were less than 3%."

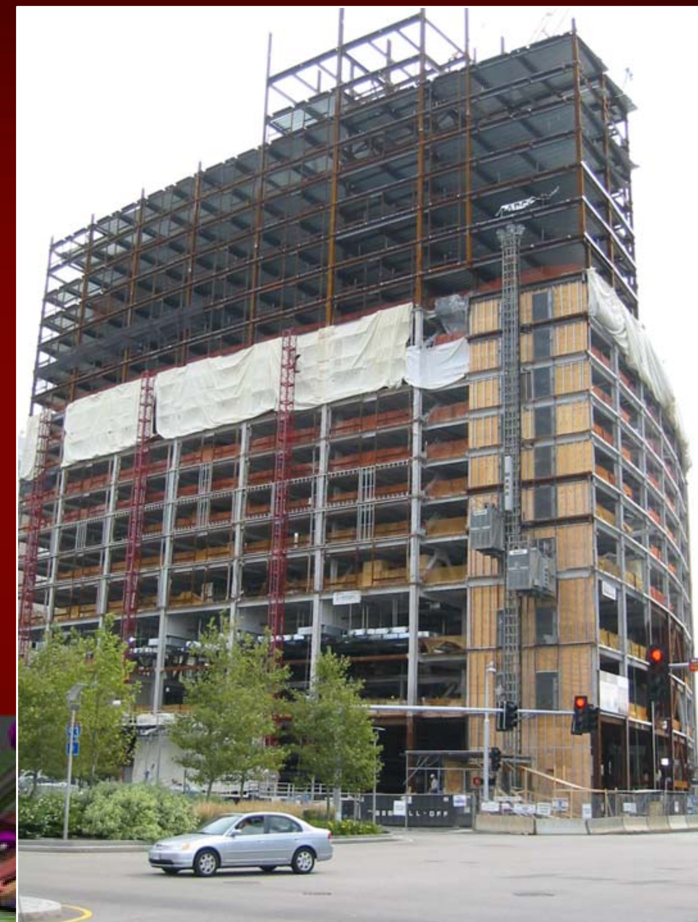
New Jersey Devils Arena
Newark, NJ

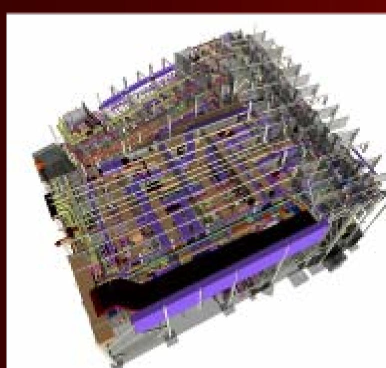
Design Assist:
CD's completed Dec 16, 2005
Steel erection began March 3, 2006

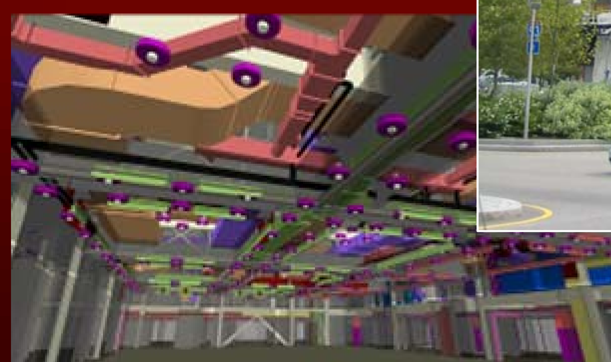
Hearst Tower
New York, NY

Steel fabricator shared model with curtain wall contractor

Renaissance Boston Waterfront Hotel



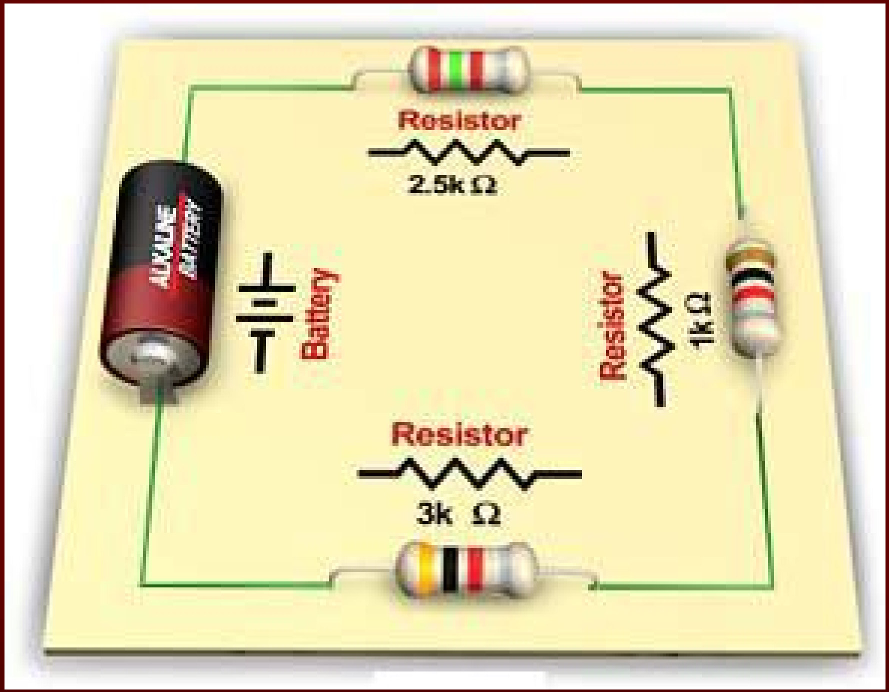




Why not more?

Designers

Owners



Specialty Contractors

General Contractors

RESISTANCES:

Additional Cost

Model Discipline

Level of Model Detail

Release of Proprietary Information

Model Ownership

Dimensional Definitions

2-D Drawings Required for Permitting

Acceptance as Contract Documents

Contractual Relationship Definitions

Model Quality

Design-Bid-Build Process

Staffing Responsibilities

Multiple Software Platforms

I Don’t Want to be First

DRIVERS:

Focus on Process more than Software (FOTA)

Document Successes

Develop Appropriate Contractual Language

Redefine “Code of Standard Practice”

Address Objections with Relevant Software

Assign Model Ownership and Responsibility

Focus on the End Result for the Project Owner

Define the Benefits for the Virtual Project Team

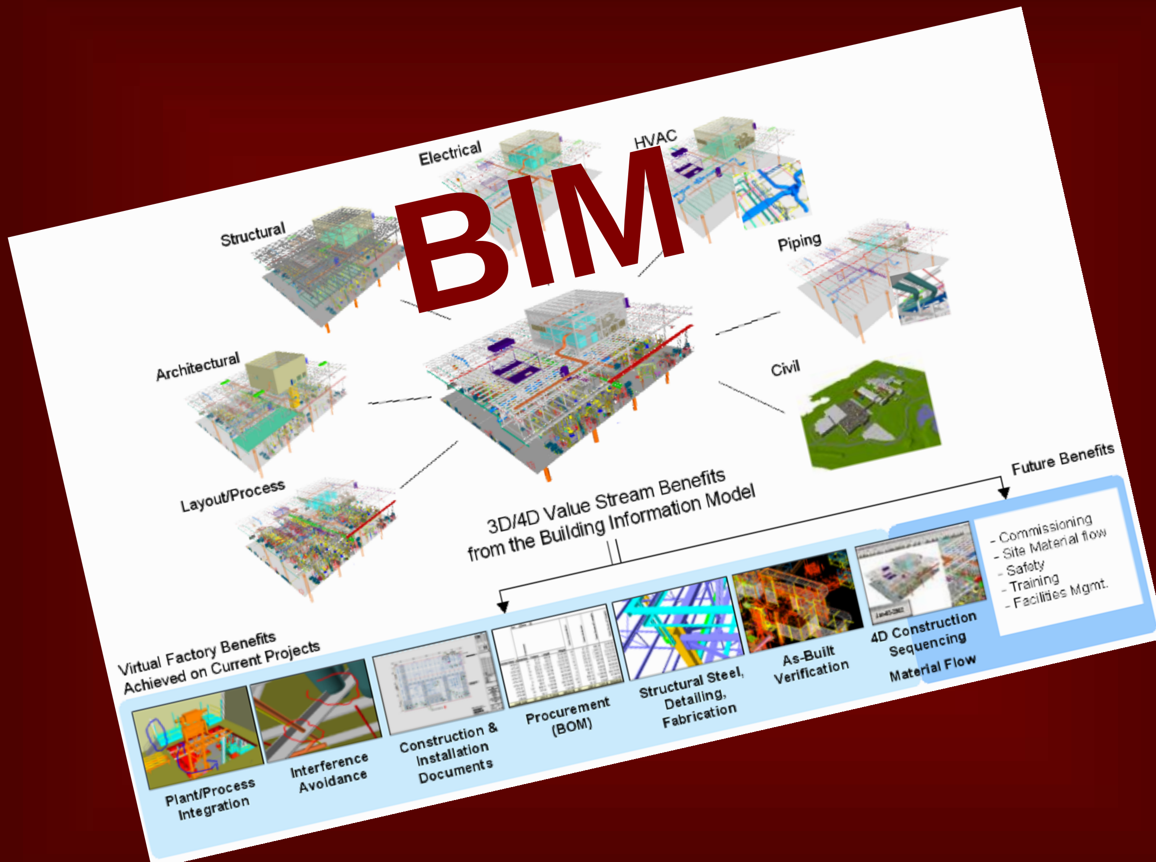
Reassess Project Compensation

Encourage Owners to Drive the Process

RECOGNIZE BIM IS NOT ANOTHER FAD!

FOCUS ON PRODUCTIVITY!

We're not just in the steel business…



We're in the productivity business!