# National Intrepid
## Center of Excellence

Bethesda, MD

RONZA ABOUSAID

SENIOR THESIS PRESENTATION

CONSTRUCTION MANAGEMENT | 2009-2010

## PRESENTATION OUTLINE

- Project Overview
- Project Delivery Method
- BIM as an effective communication tool
- Heat Recovery Systems
- Conclusion and Recommendations



# PRESENTATION OUTLINE

- Project Overview
- Project Delivery Method
  - Project Delivery Method Selection
  - CM-at-Risk vs. Design- Build
  - Schedule Analysis
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- BIM as an effective communication tool
  - The effects of the inefficient use of BIM.
  - NICoE's communication and collaboration BIM Execution Plan .
  - Benefits and challenges in using BIM in the current industry.
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  - Benefits of heat recovery systems
  - Heat recovery using enthalpy wheels
  - Energy cost savings
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# PROJECT OVERVIEW

- **Location** : National Naval Medical Center, Bethesda, MD
- **Occupants**: Military personnel/veterans suffering from traumatic brain injury and psychological issues.
- **Function**: Advanced research, diagnoses and treatment base facility.
- **Size**: 72,000 Square Feet
- **Stories**: 2 levels
- **Construction Schedule**: March 9, 2009 – May 10, 2010 (16 mo.)
- **Budget**: $45 Million
- **Delivery Method**: CM-at-Risk , MEP – Design Build
- **LEED Accreditation**: Silver



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# PROJECT OVERVIEW

**PROJECT TEAM :**

- **Owner**: The Intrepid Fallen Heroes Fund
- **Contractor**: Turner Construction
- **Architect**: SmithGroup
- **Structural** : Cagley and Associates, Inc.
- **MEP**: SmithGroup
- **Civil**: A. Morton Thomas & Assoc, Inc.
- **Soils**: Schnabel Engineering, Inc.

SMITHGROUP

Turner



# PROJECT OVERVIEW

- Quality
  - High end finishes
  - Sophisticated Medical equipment ~ CAREN system, Virtual reality equipment
  - A signature building

**CAREN System** **Virtual Reality** **Fluoroscope** **MRI Systems**

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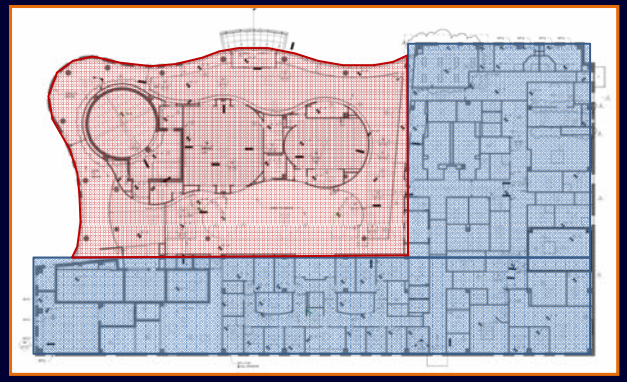
# PROJECT OVERVIEW

**BUILDING LAYOUT:**





# PROJECT OVERVIEW

- **Low Distinct Zonal Areas of the building:**
  - **"L" shaped zone contains spaces dedicated to the clinical function of the facility.**
  - **Amorphous form contains the healing and public areas of the building**

- **Northwest side : Curtainwall with precast concrete panels**
- **East and South Side: Precast concrete panels with punched in 2 floor level windows and mechanical louvers.**

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**ARCHITECTURAL FEATURES:**



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## ANALYSIS I
## PROJECT DELIVERY METHOD

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# PROJECT DELIVERY METHOD

**BACKGROUND :**

- NICoE is being delivered under a CM-at-Risk with a GMP contract type.
- 60% complete CDs when Turner became involved
- 3 stage building estimations.

**PROBLEM :**

- An over budget design
- Six CCD's have been issued
- A 5 month period of value engineering process
- Redesign of many of the building's features.
- Distorted usage of BIM

# PROJECT DELIVERY METHOD



**GOALS**

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# PROJECT DELIVERY METHOD



**GOALS**

- Validate advantages of Design-Build delivery method for NICoE

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# PROJECT DELIVERY METHOD

**THE CHOICE OF PROJECT DELIVERY METHOD :**

- **Project goals and objectives**
- **Time constraints**
- **Cost constraints**
- **Quality of the design**
- **Party at risk**
- **Existing site conditions**

| Owner's Project Objectives | Selection Factor |
|---|---|
| Complete project within budget cost | → Cost Control |
| Appearance of building must project appropriate image | → Quality |
| Accommodate special security requirements | → Quality |
| Complete construction and design within 18 months period | → Schedule |
| Minimize design and construction rework to less than 3 percent | → CCD |

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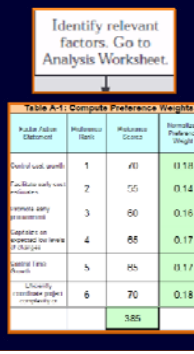
# PROJECT DELIVERY METHOD

**PROJECT DELIVERY SELECTION TOOL - CII**

- **To help select the most effective project delivery method based upon the owner's project expectations.**

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# PROJECT DELIVERY METHOD

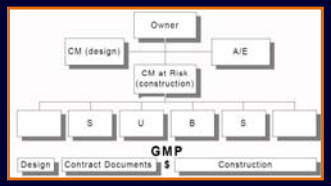
### Advantages of CM-At-Risk vs. Design Build

| | CM-At-Risk | Design Build |
|---|---|---|
| Preconstruction Services | ✓ | ✓ |
| Increase the speed of construction./Shorter Project duration time. | ✓ | ✓ |
| Strengthen coordination between the project team. | ✓ | ✓ |
| **Collaborative team working towards the same goal.** | | ✓ |
| CM hired based on qualification. | ✓ | ✓ |
| Owner control / Risk. | ✓ | |
| Full responsibility ( No finger-pointing) | | ✓ |
| Competitive bidding | ✓ | |
| Detailed overall performance warranties | | ✓ |
| **Firm Construction price early in the design** | | ✓ |
| **Guarantee the outcome of the project.** | | ✓ |
| Early involvement of specialty contractors | | ✓ |
| Decreases claims and change order abuses | | ✓ |

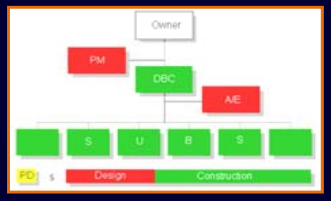
# PROJECT DELIVERY METHOD



### CM-At-Risk




### Design Build



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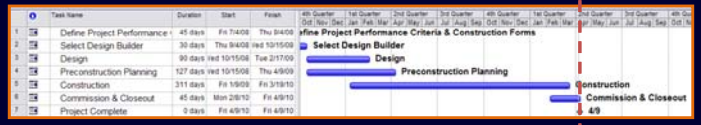
# PROJECT DELIVERY METHOD

## SCHEDULE ANALYSIS

**Current Schedule Used for NICoE**


**Proposed Design-Build Delivery Method for NICoE**




**Time Savings: 3 months!**

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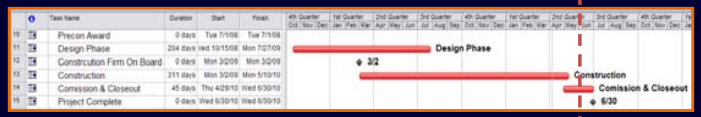
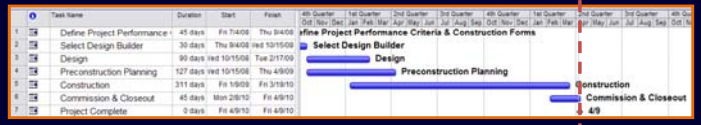



**Proposed Design-Build Delivery Method for NICoE**




**Time Savings: 3 months!**

# PROJECT DELIVERY METHOD



## CONCLUSION

- **Many of NICoE's project challenges were due to:**
  - **Lack of team collaboration**
  - **Working under two separate teams**
  - **Late contractor design involvement**
  - **The absence of specialty contractors in the early design stages**

- **There are many benefits to the owners, contractors, and designers for implementing an integrated project delivery method**

*"Compared to the traditional delivery methods used, design build has a 4.5% Lower Construction Cost, 23% Fast Delivery Speed, 7% fast Construction, 21% better quality."*

*Design-Build Solutions, Inc.*

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# ANALYSIS II
# BIM AS AN EFFECTIVE COMMUNICATION TOOL

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# BIM AS AN EFFECTIVE COMMUNICATION TOOL

**BACKGROUND :**

- A 3D Revit model was developed by SmithGroup in early design phase.
- Model required from: Arch., Struc., MEP, and Sprk.
- Model used during the 5 month Value Engineering process.

**PROBLEM :**

- **Many VE changes were not inputted into Revit model.**
- **MEP coordination was run based on some of the original building design.**
- **Poor communication between project team.**

# BIM AS AN EFFECTIVE COMMUNICATION TOOL



**GOALS**

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**GOALS**

- Demonstrate the cost and time savings when using BIM effectively.
- Improve effectiveness through a BIM execution plan focusing on: NICoE's communication, collaboration and modeling goals.
- Identify many of the benefits of BIM on the current building industry

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# BIM AS AN EFFECTIVE COMMUNICATION TOOL

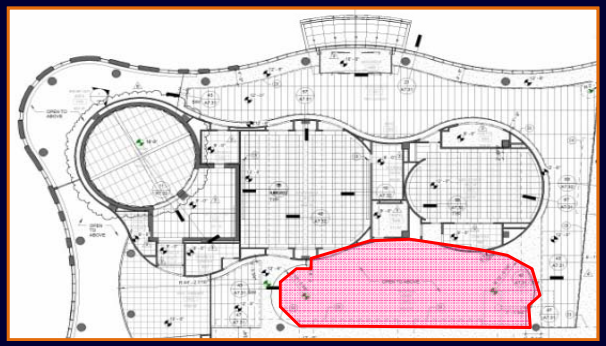
**COORDINATION ISSUE :**

2nd floor original ceiling height = 17'-8" → Redesigned 2nd floor ceiling height = 15' → Change not updated into model → Miscoordination = 2'-8"

# BIM AS AN EFFECTIVE COMMUNICATION TOOL



**CLASH LOCATION :**



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# BIM AS AN EFFECTIVE COMMUNICATION TOOL

**ON-SITE CLASH :**


Angle 1

Angle 2

**COST AND SCHEDULE EFFECTS :**

- Total cost to rework: $2,200
- Schedule delay: 44 man hours

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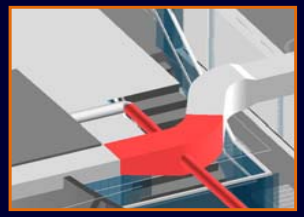
**MODELING COORDINATION:**



**COST AND SCHEDULE EFFECTS :**

- Cost and schedule are minimally effected.
- On-site rework at NICoE could've been avoided with a continuously updated BIM model

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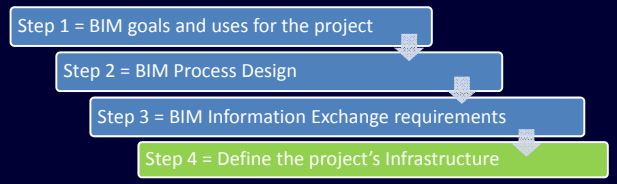
**BIM EXECUTION PLAN:**

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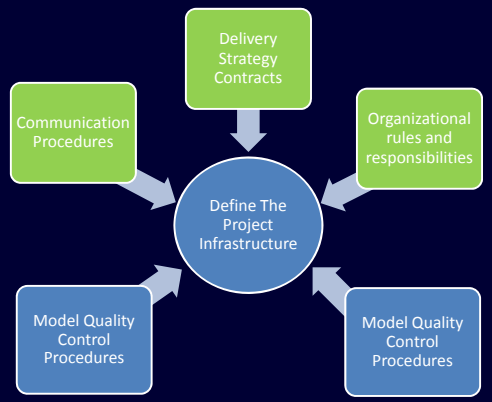

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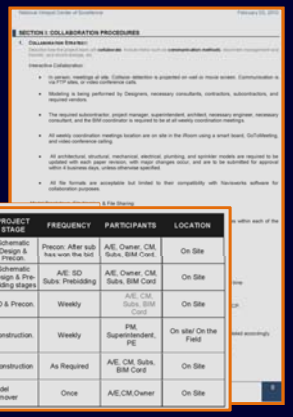
# BIM AS AN EFFECTIVE COMMUNICATION TOOL

**Communication Procedures:**

- Team collaboration, communication and document control methods.
- Meeting procedures
- Information exchange and file transfer procedures.
- Description of the BIM workspace .



| MEETING TYPE | REQUIRED PER CONTRACT | PROJECT STAGE | FREQUENCY | PARTICIPANTS | LOCATION |
|---|---|---|---|---|---|
| BIM REQUIREMENTS KICK-OFF | Yes | Schematic Design & Precon. | Precon. After sub has won the bid | A/E, Owner, CM, Subs, BIM Cord. | On Site |
| BIM EXECUTION PLAN DEMONSTRATION | Yes | Schematic Design & Pre-bidding stages | A/E: SD Subs: Prebidding | A/E, Owner, CM, Subs, BIM Cord | On Site |
| DESIGN COORDINATION | Yes | DD & Precon. | Weekly | A/E, CM, Subs, BIM Cord | On Site |
| CONSTRUCTION OVER-THE-SHOULDER PROGRESS REVIEWS | Yes | Construction. | Weekly | PM, Superintendent, PE | On site/ On the Field |
| ANY OTHER BIM MEETINGS THAT OCCURS WITH MULTIPLE PARTIES | Yes/ Major Changes to Design | Construction | As Required | A/E, CM, Subs, BIM Cord | On Site |
| ANY OTHER BIM MEETINGS THAT OCCURS WITH MULTIPLE PARTIES | YES | Model Turnover | Once | A/E,CM,Owner | On Site |

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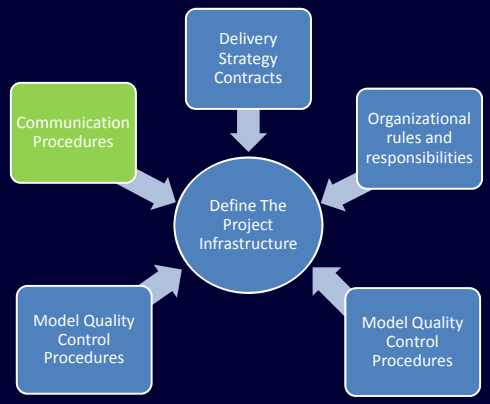

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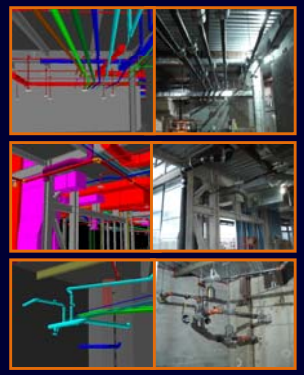
# BIM AS AN EFFECTIVE COMMUNICATION TOOL

**INDUSTRY POINT OF VIEW :**

***Jerry Shaheen – The Dickinson School of Law.***

- Model used for coordination.
- Eliminated many field conflicts between subcontractors.
- Raised profit margin.

"Using BIM on this Project is what made this project possible to be delivered on time and within the required budget" ~ Jerry Shaheen





FARFIELD

RECEIVED
JAN 12 2009

January 9, 2009

Gilbane Building Company
270 Walker Drive, Suite 102
State College, PA 16801

Attn: Mr. Jerry Shaheen

Mr. Shaheen,

I would like to take this opportunity to pass along some good news regarding the New Dickinson School of Law Building at Penn State University. This project used 3D Building Information Model (BIMS) for coordination of all trades. This was a new process for The Farfield Company and with the cooperation of the Gilbane team and the Farfield team, the entire process provided good information for the coordination of all trades involved. Also, it was very helpful with layout and installation details. This building has very unique features that with the use of the BIMS process, we recognized labor savings that resulted in an increase to our overall profitability on this project.

I want to thank you and your entire team for their effort and cooperation in making the BIMS process a huge success for the project. I have no doubt that it contributed to the overall success of this entire project.

Thank you again, for giving The Farfield Company the opportunity to be a part of your team.

Very Truly Yours,
THE FARFIELD COMPANY

John P. Himmelberger
Vice President

ELECTRICAL - MECHANICAL - CIVIL - TRANSIT

# PRESENTATION OUTLINE

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# BIM AS AN EFFECTIVE COMMUNICATION TOOL

**OTHER TECHNICAL BENEFITS :**

***Model-Based Cost Estimation– Analysis III***

- Leaner Approach
  - Faster process
  - Eliminates scope of errors and omissions
  - Alternative systems evaluation (Façade alternative system)

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# BIM AS AN EFFECTIVE COMMUNICATION TOOL

## Conclusion

- BIM enables you to ***" Begin with the end in mind"***
- There are countless benefits and obstacles to BIM in the current building industry.
- A BIM Execution Plan is essential to all projects utilizing BIM.
  - Constant communication and collaboration between the project team.
  - Specific model requirements for each party involved.

*"I think eventually it's going to rewrite how we word our contracts with clients and contractors, and it's going to rework our traditional phases from schematic design and design development through bid negotiations and the construction phase," Meyer says. "The product enables all the industry players to work together."*

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# ANALYSIS III
# HEAT RECOVERY SYSTEMS
## Mechanical Analysis

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# HEAT RECOVERY SYSTEMS
## Mechanical Analysis

**BACKGROUND :**

- After construction began, Turner was given MEP as a Design Build Contract.
- Limback Co. designed two alternative AHU systems.
- AHUs: 37,000CFM supply air.
- 14,000CFM outside air.

**PROBLEM :**

- **No energy recovery in AHU.**
- **Lost energy cost savings for the owner.**

# HEAT RECOVERY SYSTEMS



**GOALS**

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# HEAT RECOVERY SYSTEMS



**GOALS**

- Demonstrate the benefits of heat recovery systems.
- Design an efficient heat recovery system (enthalpy wheel) which can be used for this facility.
- Demonstrate the building's energy cost savings when investing in these systems

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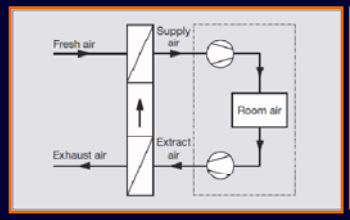
# HEAT RECOVERY SYSTEMS

**BENEFITS OF HEAT RECOVERY SYSTEMS:**

- Up to 90% efficiency
- Lower energy consumption
- Lower investment for heat generation and distribution.
- Less damage to the environment.

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# HEAT RECOVERY SYSTEMS

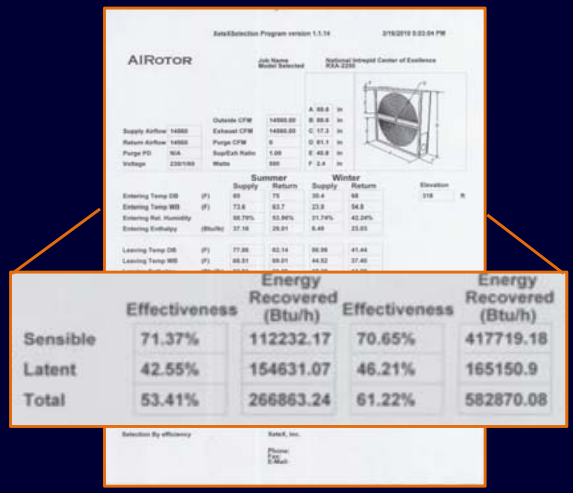
## HEAT RECOVERY USING ENTHALPY WHEELS:

- Function
  - Absorbs latent and sensible heat

## NICOE ENTHALPY WHEEL DESIGN:

- Xetex Inc. in Baltimore, MD.
  - A heat recovery selection system (*XETEXSELECTION PROGRAM VERSION 1.1.14)*
- Enthalpy Wheel System = RXA-2250
  - Energy recovery in the summer = 266,863 BTU/HR = 78.2 KW-hr
  - Energy recovery in the winter = 582,870 BTU/HR = 170.8 KW-hr






| | Summer Effectiveness | Summer Energy Recovered (Btu/h) | Winter Effectiveness | Winter Energy Recovered (Btu/h) |
|---|---|---|---|---|
| Sensible | 71.37% | 112232.17 | 70.65% | 417719.18 |
| Latent | 42.55% | 154631.07 | 46.21% | 165150.9 |
| Total | 53.41% | 266863.24 | 61.22% | 582870.08 |

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# HEAT RECOVERY SYSTEMS

**ENTHALPY WHEELS ENERGY COST SAVINGS:**

- Winter:
  - Gas = $230.16 per day = $41,428 per year
- Summer:
  - Electricity = $130.00 per day = $23,4000 per year
- **Total Savings = $65,000 per year**

**SYSTEMS COST ANALYSIS:**

- Material Cost = $11,450
- Installation Cost = 25% = $2,862

**Very Low Life Cycle Cost !**

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# HEAT RECOVERY SYSTEMS

**CONCLUSION:**

- Specialty contractors offer valuable ideas when involved early in the design phase compared to late in the construction process.

- Heat recovery systems: reduced energy cost, energy efficient, and has a very low life cycle cost.

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# CONCLUSION AND RECOMMANDATIONS

- Efficient use of BIM on a project requires:
  - A detailed BIM execution plan:
    - Goals, uses, model requirements, model updates, responsibilities, communication, and collaboration methods.
  - A constant collaborative project team.
- Adding efficiency to building systems
  - Heat recovery systems - Enthalpy Wheel (RXA-2250)
    - Saves a total = $64,828 per year
    - Very Low life cycle cost

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# CONCLUSION AND RECOMMENDATIONS



- Moving towards an integrated project delivery method.
- Collaborative construction and design project team which are working towards the same goal:
  - Minimizes redesigns due designs exceeding the budget.
  - Eliminates the long value engineering period due to having to separate interest.
  - Eliminates the distorted usage of BIM.
  - Requires specialty contractors inputs in the value, efficiency and constructability of the building systems.

*"This facility will provide treatment that is available nowhere else in the world," said Phil Tobey, a senior vice president at SmithGroup. "With its comprehensive programs and advanced technology, we believe this facility will accelerate the U.S. leadership in the treatment of traumatic brain injuries, and provide the best possible care for the men and women of our armed services."*

# National Intrepid Center of Excellence

**Bethesda, MD**

RONZA ABOUSAID

http://www.engr.psu.edu/ae/thesis/portfolios/2010/raa5025/index.html

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