The Rise of Big Data

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Big What?

Let’s solve this problem by using the big data none of us have the slightest idea what to do with.
What is Big Data?

• “Big Data” is high **volume, velocity and variety** information assets that allow cost-effective, innovative forms of information processing for enhanced insight and decision making. – Gartner, Inc.

• “Big Data” refers to the use of **predictive analytics**, user behavior analytics, or certain other advanced data analytics methods that extract value from data, and to a particular data size of Wikipedia – Wikipedia

• Predictive Analytics is the practice of extracting information from existing data sets in order to determine patterns and predict future outcomes. – Gartner, Inc.
It’s All About Data

Unfiltered Data

Filtered Data

Big Data

Variation
Closer Look @ Big Data

Variation

- Budgeting w/o Functions and KPI's
- Functional Program w/KPIs
- Conceptual Design to Design Development
- Procurement to Delivery
- Final Design & Cost
Predictions are only as good as the data supporting them!

Disciplined Data Governance:
• Record Data in a Complete, Consistent, & Standard Way
• Decipher Critical Data From Junk
• Nucleus of Critical Data – Typically Less Than 200 Data Points

Lack of standardization makes comparison extremely challenging
Which Data to Extract?

Start with **Critical Data** standardized across many organizations

**Facility Purpose:**
- Cancer Center

**Departments:**
- Medical Oncology
- Radiation Oncology
- Physician Offices
- Therapy
- Administration

**Functions:**
- Linear Accelerator
- CT Simulator
- PET/CT Scanning
- HDR Procedure
- Exams (Specialized)
### Which Data to Extract?

Start with **Critical Data** standardized across many organizations

<table>
<thead>
<tr>
<th>KPI’s (Attributes)</th>
<th>Key Parameters</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Parking</td>
<td>Approval to Design</td>
</tr>
<tr>
<td>Owner Type</td>
<td>Vertical Circulation</td>
<td>Design to Mobilize</td>
</tr>
<tr>
<td>Shell Type</td>
<td>Core &amp; Common</td>
<td>Mobilize to Enclosure</td>
</tr>
<tr>
<td>Quality</td>
<td>Building Configuration</td>
<td>Enclosure to Occupancy</td>
</tr>
<tr>
<td>Durability</td>
<td>Site/Building Quantities</td>
<td></td>
</tr>
<tr>
<td>Energy/LEED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...and so on</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

...and so on
Systems Approach

Start with **Critical Data** standardized across many organizations

Costs

- Hard Costs
- Soft Costs

Groups

- A – Substructure
- B – Shell
- C – Interiors
- D – Services
- E – Equipment
- F – Special Construction
- G - Sitework

Systems

- B – Shell
  - B2010: Exterior Walls
  - B2020: Exterior Windows
  - B2030: Exterior Doors
  - ….and so on
Ability to Impact Cost

Cost of Change

Start

Time

Finish
Boldt’s Predictive Analytics Journey

2005 – Systems Approach based on Functional Requirements

2017 – Big Data with Systems Approach

Need & Feasibility
Scope & Approval
Program
Conceptual Design
Schematic Design
Design Development
Contract Documents
Procure & Construct

Effort Curve
Traditional Delivery

Effort Curve
IPD Delivery
Big Data
Total Solution

Effort Curve
Big Data
Bigger Decisions
Big Decisions
Extracting Boldt’s Existing Data
Understanding Existing Data

Data analysis normalized to selected location and time

- Most Efficiently Programmed, Designed and Produced Projects
Understanding Existing Data - Cost

- 13 of 15 projects produced within 7% of predicted (market average) cost – 2 outliers
- Sampling average of all projects is 2.7% less than market average
Understanding Existing Data - Program

- 11 of 15 projects exceed 7% variation from market average program and plan.
- Sampling average of all projects is 4% less than market average.

![Program and Plan Efficiency Chart]

- Program and Plan Outliners
- Sampling Average
- Program and Plan Outliners
- Material and Cost Efficiency
Exam Room Illustration

Gross Building Area per Exam Room ranges from: 365 SF to 645 SF (~80% difference)

Resulting Cost per Exam Room ranges from: $95,000 to $196,000 (>100% difference)
Exterior Wall Illustration

Cost per Wall Area ranges from: $34/SF to $99 (~ 3 times)
What We Learn From This Data

1. High variation exists at project details (validates studies showing excessive waste)
2. Low variation exists at project summary (helps conceal the excessive waste)
3. Greatest variation is within facility program/design (Not material specification and building production.)
4. Most projects can be effectively steered to desired outcomes (Starting in the pre-program stages)
5. Project outcomes can be reliably predicted in the conceptual design stages.
6. Variations to approved target can be readily discovered and managed.
Applying This Data to Predict Future Results

Conceptual Modeling

Rapid scenario prototyping and dialing in to most likely results – in conceptual modeling stages

<table>
<thead>
<tr>
<th>Project Set</th>
<th>Bidg Area</th>
<th>Total</th>
<th>$/SF</th>
<th>Pct Low</th>
<th>Total</th>
<th>$/SF</th>
<th>Pct High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 1 - Program Model</td>
<td>24,225 SF</td>
<td>$7,098,453</td>
<td>$316</td>
<td>6%</td>
<td>$7,078,357</td>
<td>$292</td>
<td>16%</td>
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<tr>
<td>Set 1-1 - Market Average Based on Program</td>
<td>24,571 SF</td>
<td>$7,106,924</td>
<td>$296</td>
<td>8%</td>
<td>$6,675,212</td>
<td>$263</td>
<td>17%</td>
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<tr>
<td>Set 2a - Conceptual Drawings Market Average</td>
<td>20,072 SF</td>
<td>$7,427,099</td>
<td>$285</td>
<td>7%</td>
<td>$6,665,440</td>
<td>$204</td>
<td>16%</td>
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<tr>
<td>Set 2A-1: Conceptual Drawings Market Average</td>
<td>25,141 SF</td>
<td>$7,241,181</td>
<td>$288</td>
<td>7%</td>
<td>$6,706,098</td>
<td>$287</td>
<td>16%</td>
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<tr>
<td>Set 2B-1: Conceptual Drawings Boldt Benchmark</td>
<td>25,141 SF</td>
<td>$7,048,434</td>
<td>$280</td>
<td>3%</td>
<td>$6,601,861</td>
<td>$271</td>
<td>7%</td>
</tr>
</tbody>
</table>

Low and high range points are at 1.0 Std Dev = 86% probability.

![Chart showing distribution of project set costs](chart.png)
Deming, Lean and Back Again

W. E. Deming

Lean Construction

Lean Manufacturing

Toyota Production System
Big Data and Lean Construction

According to Deming

• Process Improvement
  • Objective Knowledge
    • Impartial Prediction and Analysis
      • Big Data – Within & Outside The Organization
        • Standardized Systems Approach
        • Disciplined Data Governance
        • New Forms of Data Processing
Big Data and Lean Construction

Impartial Prediction and Analysis

• Target Value Delivery (TVD)
• Choosing By Advantages (CBA)
• Set-Based Planning/Design (aka Concurrent Engineering)

Success Story
In the spirit of continuous improvement, we would like to remind you to complete this session’s survey in the Congress app! We look forward to receiving your feedback. Highest rated presenters will be recognized.